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CLAIMS

[Claim(s)]

[Claim 1]A rechargeable battery which has arranged a safety circuit which has a current cutoff element in an obturation part which obturates a battery element with a cap.

[Claim 2]The rechargeable battery according to claim 1 which processed a safety circuit with waterproofness like an epoxy resin and polybutylene terephthalate resin, and ***** acidity-or-alkalinity resin.

[Claim 3]The rechargeable battery according to claim 1 which provided an opening or a breaking mechanism in a safety circuit board which has arranged a safety circuit.

[Claim 4]The rechargeable battery according to claim 1 which has arranged a thermal cutout to a safety circuit.

[Claim 5]The rechargeable battery according to claim 1 which has arranged a thermo sensitive register to a safety circuit.

[Claim 6]The rechargeable battery according to claim 1 connected to a safety circuit via a PCT element from a plus output of a rechargeable battery.

[Claim 7]The rechargeable battery according to claim 1 which has arranged a PTC element between a plus pole of a safety circuit, and a plus pole for external I/O.

[Claim 8]The rechargeable battery according to claim 1 which considered a cap of an obturation part as 2 pole composition of a minus pole for safety circuits, and a plus pole for external I/O.

[Claim 9]The rechargeable battery according to claim 8 which provided a level difference in a minus pole for safety circuits, and a plus pole for external I/O.

[Claim 10]The rechargeable battery according to claim 8 with which a minus pole for safety circuits and a plus pole for external I/O pasted up with adhesives of electric insulation, or were assembled via an insulating material.

[Claim 11]The rechargeable battery according to claim 8 which enlarged a path of an outgassing bore provided in a plus pole for external I/O to a path of an outgassing bore provided in a minus pole for safety circuits.

[Claim 12]An assembly obturation board with which an opening of a cell case which accommodates a power generation element and serves as polar terminal of one of these, and a cell case was equipped via a gasket is provided, An inside cap and an outer cap with which said assembly obturation board was insulated electrically mutually, And consist of a metallic thin plate fractured by a predetermined pressure, and a valve element which has a current shutting off function means to sever electrical continuity in advance of a fracture is included, A rechargeable battery having a hollow part which one side of said cap is pushed in said valve element, it is electrically connected with a polar electrode of another side of a power generation element, and both caps have a bore for discharging gas, respectively, and is open for free passage to said both bores among both caps.

[Claim 13]An assembly obturation board with which an opening of a cell case which accommodates a power generation element and serves as polar terminal of one of these, and a cell case was equipped via a gasket of electric insulation is provided, Said assembly obturation board incorporates

an electric circuit containing voltage detection circuits which detect voltage of a current cutoff element and a cell which were connected to a cell in series, and control said current cutoff element, And a printed circuit board which has a bore or a breaking mechanism for discharging gas, An outer cap which was connected to a polar terminal area of a printed circuit board different, respectively, and was attached on said printed circuit board, and an inside cap, It is allotted to the cell inside from said printed circuit board, and consists of a metallic thin plate fractured by a predetermined pressure, An electrical connecting means which pushes a valve element which has a current shutting off function means to sever electrical continuity in advance of a fracture, and a terminal area connected to one cap of said printed circuit board in said valve element, and is electrically connected with a polar electrode of another side of a power generation element is included, A rechargeable battery when it has a hollow part which both caps have a bore for discharging gas, respectively, and is open for free passage to said both bores among both caps, and a cell is set to apparatus, wherein said electric circuit is connected to said one polar terminal via a cap of another side.

[Claim 14]The rechargeable battery according to claim 13 controlled so that a current cutoff element in an electric circuit intercepts an input of an over-current to a cell, an output of an over-current from a cell, or input and output of an over-current.

[Claim 15]The rechargeable battery according to claim 12 or 13 currently formed inside a bulged part which both caps have a bore for discharging gas on the side, respectively, and a hollow part provided in the side of an outer cap.

[Claim 16]The rechargeable battery according to claim 15 with which a bulged part is provided in a top edge part of an outer cap.

[Claim 17]The rechargeable battery according to claim 14 or 15 with which a bore of an outer cap is provided in a low rank from a bore of an inside cap.

[Claim 18]The rechargeable battery according to claim 13 with which an electrical connecting means contains a PTC element.

[Claim 19]An electrical connecting means is welded by valve element in a center section, and contains a preliminary filter electrically insulated in an edge part, The rechargeable battery according to claim 13 which works as a current shutting off function means to separate if gas pressure which said preliminary filter has a male bore in gas, and a welding of said preliminary filter and said valve element requires for a valve element exceeds a predetermined value, and to sever an electrical link of a preliminary filter and a valve element.

[Claim 20]The rechargeable battery according to claim 13 arranging a package which provided a terminal which unifies an electric circuit containing voltage detection circuits which detect voltage of a current cutoff element and a cell which replaced with a printed circuit board and were connected to a cell in series, and control said current cutoff element, and is equivalent to a terminal area of said printed circuit board.

[Claim 21]It consists of an inside cap insulated electrically mutually, an outer cap, and a metallic thin plate fractured by a predetermined pressure, A valve element which has a current shutting off function means to sever electrical continuity in advance of a fracture, and a means to push one side of said cap in said valve element, and to electrically connect with one polar electrode of a power generation element are provided, An assembly obturation board for rechargeable batteries, wherein both caps have a hollow part which has a bore for discharging gas and is open for free passage to said both bores among both caps, respectively.

[Claim 22]An electric circuit containing voltage detection circuits which detect voltage of a current cutoff element and a cell which are connected to a cell in series, and control said current cutoff element is incorporated, And a printed circuit board which has a bore or a breaking mechanism for discharging gas, An outer cap which was connected to a polar terminal area of a printed circuit board different, respectively, and was attached on said printed circuit board, and an inside cap, It is allotted to the cell inside from said printed circuit board, and consists of a metallic thin plate

fractured by a predetermined pressure, An electrical connecting means which pushes a valve element which has a current shutting off function means to sever electrical continuity in advance of a fracture, and a terminal area connected to one cap of said printed circuit board in said valve element, and is electrically connected with one polar electrode of the power generation elements is included, An assembly obturation board for rechargeable batteries, wherein both caps have a hollow part which has a bore for discharging gas and is open for free passage to said both bores among both caps, respectively.

[Claim 23] Voltage of a current cutoff element and a cell which replaced with a printed circuit board and were connected to a cell in series is detected. The assembly obturation board for rechargeable batteries according to claim 22 arranging a package which provided a terminal which unifies an electric circuit containing voltage detection circuits which control said current cutoff element, and is equivalent to a terminal area of said printed circuit board.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] In this invention, it is related with the cell which contained the safeguard in the sealed type rechargeable battery of a rechargeable lithium-ion battery etc. Therefore, especially the electric circuit of a safeguard is miniaturized and it is related with the assembly obturation board for rechargeable batteries which built into the obturation circles of a cell the thing which carried out mounting arrangement, and the safeguard.

[0002]

[Description of the Prior Art] The demand as a power supply for a drive of small portable devices, such as a video camera, a cellular phone, and a personal computer, has expanded the rechargeable lithium-ion battery quickly from the place which has high energy density also in a sealed type rechargeable battery. This rechargeable lithium-ion battery needs a safeguard including the electric circuit as a safety circuit for protecting from overcharge, overdischarge, and an over-current. Then, it is usually included in a cell use device as a packed type cell which combined the electric circuit as a safety circuit with the cell.

[0003] The packed type cell using a rechargeable lithium-ion battery, It is composition like drawing 1 in which a mimetic diagram is shown, and the case which mounts 1 in the shape which can equip a feed unit with the cylindrical rechargeable lithium-ion batteries 2 and 3, and 4 are the safety circuits inserted between the terminals of the rechargeable lithium-ion batteries 2 and 3 and the case 1 in drawing 1.

[0004] The composition of the safety circuit 4 in the former is shown in drawing 17 as a block diagram, and the positive voltage from a battery charger, Charge of the rechargeable lithium-ion batteries 2 and 3 is performed by flowing into the minus side of a battery charger via the positive terminal 5, PTC element 6, the rechargeable lithium-ion batteries 3 and 2, FET7 and 8, the thermal cutout 9, and the terminal 10.

[0005] Discharge of the rechargeable lithium-ion batteries 2 and 3 is performed via plus of PTC element 6, the positive terminal 5, and apparatus and minus, the negative terminal 10, the thermal cutout 9, FET8, and 7. It is connected to the control circuit 13, and if the voltage detection circuits 11 and 12 which supervise cell voltage will turn OFF FET8, will carry out the function of the prevention from overcharge, if cell voltage becomes higher than default value, and they become lower than default value, they will turn OFF FET7, will carry out the function of overdischarge prevention, and will intercept current. When it is connected to the control circuit 13 and excessive current occurs by an external short circuit etc. between the negative terminals 10 from the positive terminal 5, the voltage detection circuits 14 which detect the voltage between the sauce drains of FET7 turn OFF FET7 and 8, and intercept current. The thermo sensitive register 15 monitors the temperature of a cell from the battery-charger or use device side via the terminal 16.

[0006]As mentioned above, mounting arrangement is carried out as the safety circuit 4 at a printed circuit board, and the function to prevent the surcharge of a cell simple substance, the function to prevent overdischarge, the interception function at the time of excessive current, the battery temperature monitor function, etc. comprise a conventional packed type cell inside the case 1.

[0007]

[Problem(s) to be Solved by the Invention]If it was in the above conventional packed type cells, there was a problem that it explained below.

[0008]1) Since the shape and the design of the case 1 are formed so that it may be easy to equip a feed unit with a packed type cell, the case 1 becomes a thing for exclusive use corresponding to a feed unit in many cases.

[0009]2) Since the case 1 is the shape and the design with which a feed unit can be equipped, it is necessary to align a battery charger with the case 1, and the battery charger for exclusive use corresponding to a feed unit is needed.

[0010]3) It is necessary to establish the terminal structure made the shape and the design for equipping a safety circuit and a feed unit, and becomes very large compared with the volume of the rechargeable lithium-ion batteries 2 and 3 with which the volume resulting from these is stored.

[0011]4) General consumers cannot obtain rechargeable battery simple substances, such as a lithium ion, easily. Thus, the conventional packed type cell was lacking in flexibility.

[0012]Especially this invention has included the electric circuit which constitutes a safeguard in the inside of a cell, and an object of this invention is to provide the rechargeable battery with a safeguard which can treat itself like the conventional cell simple substance.

[0013]An object of this invention is to provide the rechargeable battery provided with the obturation board which can discharge gas to the exterior easily, when the inside of a cell becomes unusual high voltage and a valve element fractures.

[0014]

[Means for Solving the Problem]In order to solve the above-mentioned problem, suppose a rechargeable battery of this invention that a safety circuit which has a current cutoff element is arranged in an obturation part. And like [between a cap and a current cutoff valve of an obturation part in the upper part of a rechargeable battery], Usually, by arranging a microminiaturized safety circuit, into a portion which cannot touch an electrolysis solution directly, the rechargeable battery itself which built in a safety circuit can be treated like the conventional cell simple substance at the time, and it can store a rechargeable battery easily to a cell storage room of a feed unit into it.

[0015]This invention improves an assembly obturation board with which an opening of a cell case which while accommodated a power generation element and serves as a polar terminal is equipped via a gasket. Namely, an inside cap and an outer cap with which an assembly obturation board by this invention was insulated electrically mutually, And consist of a metallic thin plate fractured by a predetermined pressure, and a valve element which has a current shutting off function means to sever electrical continuity in advance of a fracture is included, One side of said cap is pushed in said valve element, it is electrically connected with a polar electrode of another side of a power generation element, and both caps have a bore for discharging gas, respectively, and it has a hollow part which is open for free passage to said both bores among both caps.

[0016]Gas which was emitted so much at a stretch and fractured a valve element by existence of this hollow part shifts to a bore of an outer cap easily from a bore of an inside cap, and is emitted outside. A fear of a cell exploding by this can be lost.

[0017]

[Embodiment of the Invention]Like [between the cap and current cutoff valve of an obturation part which this invention is an upper part / of a cell /, i.e., plus pole, side, and are formed with the gasket etc. which fix a cap, a PTC element, an explosion proof valve, a current cutoff valve, and these], Usually, make current cutoff elements, such as voltage detection circuits and FET, the portion which cannot touch an electrolysis solution directly with basic constitution at the time, arrange the

safety circuit which comprised electronic parts, such as a control circuit, a capacitor, resistance, and a fuse, and by this, The rechargeable battery which contained the safety circuit is treated like the conventional cell simple substance, and it can store easily to the cell storage room of a feed unit.

[0018]A safety circuit protects the safety circuit unit from the electrolysis solution of a cell itself [processing of waterproofness and ***** acidity or alkalinity, i.e., coating treatment, the water which carried out closure processing and invaded from the outside, and], for example by an epoxy resin, polybutylene terephthalate resin, etc.

[0019]Provide an opening in a safety circuit board, or it is made for some safety circuit boards to fracture by the internal pressure rise of a cell, The electrolysis solution which invaded into the safety circuit unit, or the gasified electrolysis solution can be emitted out of a cell from the outgassing bore of a cap part through the opening of a safety circuit board, a cavity part, or a breaking mechanism.

[0020]The electric connection between the plus pole of a cell and the plus output terminal to the exterior can be intercepted by arranging a thermal cutout to a safety circuit and blowing out a thermal cutout by generation of heat of a cell itself [current cutoff elements, such as FET, or].

[0021]The safety of a cell is securable by arranging a thermo sensitive register to a safety circuit, and specifying a charge temperature requirement.

[0022]It can connect with a safety circuit via a PTC element, and the trip of the PTC element can be carried out also by generation of heat of current cutoff elements, such as FET.

[0023]It replaces with a ring shape PTC element (equivalent to PTC21 in drawing 2), A PTC element can be arranged between the plus pole of a safety circuit, and an external I/O plus pole, and the trip of the PTC element can be carried out also with the time of the excessive current by the short circuit of a cell output, etc., the temperature of a cell, or the temperature of a safety circuit.

[0024]Consider the cap of an obturation part as 2 pole composition of the minus pole for safety circuits, and the plus pole for external I/O, and the minus pole of the peripheral face of a cell or the bottom and the minus pole for safety circuits until it is connected by the feed unit or battery-charger side, Since the consumed electric current of a safety circuit is not generated, the overdischarge protection feature of a cell can be made unnecessary. The safety circuit can usually microminiaturize and arrange into the portion which cannot touch an electrolysis solution directly together with the high-density-assembly art of mounting the high integration art of a semiconductor, the miniaturization technology of parts, and these, at the time like [between the cap and current cutoff valve in the obturation part in the upper part of a cell].

[0025]The external short circuit which provides a level difference in the minus pole for safety circuits and the plus pole for external I/O in a cap, and happens at the time of the handling of a cell can be made hard to generate.

[0026]The minus pole for safety circuits and the plus pole for external I/O in a cap, It can assemble via the thing electrically pasted up with thermosetting adhesives, such as insulating adhesives, for example, an epoxy system etc., or an electric insulating material, and the immobilization and the insulation between the minus pole for safety circuits of intensity reservation of the whole cap and a cap and the plus pole for external I/O can be made good.

[0027]The electric short circuit in the circumference of the outgassing bore of a cap part can be made hard to enlarge the path of the outgassing bore by the side of the plus pole for external I/O, and to generate to the path of the outgassing bore of the minus pole for safety circuits in a cap.

[0028]The cell case which serves as the terminal of one polarity [rechargeable battery / of the desirable composition by this invention], And the assembly obturation board with which the opening of the cell case was equipped via the gasket is provided, and the printed circuit board incorporating the electric circuit containing the voltage detection circuits with which said assembly obturation board detects the voltage of the current cutoff element and cell which were connected to the cell in series, and controls said current cutoff element is included. This printed circuit board has a bore for

discharging gas, and, moreover, the outer cap connected to the polar terminal area from which a printed circuit board differs, respectively, and the inside cap are attached on the printed circuit board.

[0029]The valve element which consists of a metallic thin plate which an assembly obturation board is further arranged on the cell inside from a printed circuit board, and is fractured by a predetermined pressure, And the electrical connecting means which pushes the terminal area connected to one cap of said printed circuit board in said valve element, and is electrically connected with the polar electrode of another side of a power generation element is included. And it has a hollow part which an outer cap and an inside cap have a bore for discharging gas, respectively, and is open for free passage to said both bores among both caps, and said valve element is constituted so that electrical continuity may be severed in advance of a fracture. Said electric circuit is connected to said one polar terminal via the cap of another side, when a cell is set to apparatus.

[0030]The 1st feature of this composition is having a hollow part which is open for free passage to the bore of both caps between an outer cap and an inside cap. This hollow part serves for the gas by which the inside of a cell became unusual high voltage, and fractured the valve element as mentioned above to make shift to the bore of an outer cap easily from the bore of an inside cap. If it is in the position to which the bore provided in both caps corresponds, respectively, it is not necessary to provide the aforementioned hollow part specially. In order to have such composition, alignment is needed at the time of an assembly of a cap, and it becomes complicated on work. When the position of the bore of both caps is in agreement, a linear metallic member like a hair pin enters into both bore, and electrically connects both caps, and there is a possibility that the inconvenience of short-circuiting a cell may arise. According to this invention, the special management for coinciding a bore at the time of an obturation board assembly is also unnecessary, and, moreover, anxiety of the short circuit by a line metallic member can be lessened.

[0031]As for an outer cap and an inside cap, it is preferred to be formed inside the bulged part which has said bore for discharging gas, respectively on the side, and said hollow part provided in the side of the outer cap. By this composition, the space in an inside cap is utilizable for the maximum.

[0032]As for an outer cap, it is preferred to provide a bulged part in the upper surface edge part. When this bulged part sets a cell to apparatus, the terminal area of apparatus can be equipped with it at a snap hook type.

[0033]As for the bore for discharging the gas of an outer cap, in the composition which provided the bulged part in the upper surface edge part of the outer cap, providing in a low rank is more preferred than the bore of an inside cap. According to this composition, for example, a linear metallic member like a hair pin enters into the cavity part between inside caps from the bore of an outer cap, and electrically connects both caps, and what short-circuits a cell is lost.

[0034]As for the electric circuit included in said printed circuit board, it is preferred to have a function which intercepts the input of the over-current to a cell, the output of the over-current from a cell, or input and output of an over-current. For example, it constitutes so that a current cutoff element may be turned off, when said voltage detection circuits detect the voltage between the input side of said current cutoff element, and an output side and the voltage detected exceeds predetermined voltage.

[0035]As for said electric circuit, it is preferred to constitute so that said current cutoff element may be turned off, when it has a thermometric element and the temperature detected separates from a predetermined temperature requirement.

[0036]As for said electric circuit, it is preferred that the thermal cutout connected with the cell at series is included.

[0037]As for said electrical connecting means, it is preferred that a PTC element is included further. This PTC element can also be included in the electric circuit included in said printed circuit board

instead of including in this electrical connecting means.

[0038] Still more preferably said electrical connecting means, It is welded by said valve element in a center section, and the preliminary filter electrically insulated in the edge part is included, Said preliminary filter has a male bore in gas, and the welding of said preliminary filter and a valve element is constituted so that it may work as a current shutting off function means which will separate if gas pressure exceeds a predetermined value.

[0039] The terminal which carries out the mold of the electric circuit part containing the voltage detection circuits which detect the voltage of the current cutoff element and cell which replaced with said printed circuit board and were connected to the cell in series, and control said current cutoff element like IC, unifies, and is equivalent to the terminal area of said printed circuit board is provided, The package which provided the cavity part between this terminal can be arranged.

[0040] Since the space which incorporates the safety circuit of a cell into the inside cap of an assembly obturation board is securable according to this invention, like before, It is not necessary to consider it as the battery pack which suits only the specific cell use device which combined the safety circuit besides the cell, and the independent cell which contained the safety circuit can be provided.

[0041]

[Example] Hereafter, the example of this invention is described with reference to drawing 16 from drawing 2.

[0042] (Example 1) Drawing 2 shows the sectional view of the obturation part of a cylindrical rechargeable lithium-ion battery, drawing 3 (a) shows the exploded perspective view of the enclosed regio oralis, and drawing 3 (b) shows the decomposition sectional view of the enclosed regio oralis. This obturation part has an explosion proof valve which is an explosion-proof function means when the PTC element which is a current reduction function means at the time of cell generation of heat, the current cutoff valve which is the current shutting off function means at the time of an inter-cell-pressure rise, and inter cell pressure go up further, It comprises the filter 17, the preliminary filter 18, the inner gasket 19, the valve element 20, PTC element 21, the cap 22, the obturation board ring 23, and the gasket 24. Usually, the current from an anode is connected to the filter 17 which has the bore C via the lead board 25, subsequently field contact of the time is carried out with this, and it leads to the preliminary filter 18 which has the bore B. It is led to the cap 22 on which the preliminary filter 18 and the valve element 20 have the bore D through PTC element 21 of the ring shape which the current of the anode passed along the valve element 20, and carried out field contact with this since the center section was joined by welding.

[0043] The cap 22, PTC element 21, and the valve element 20 are unified by the inner gasket 19 of ring shape.

Since this inner gasket 19 fabricates insulators, such as polycarbonate, the electric connection between the preliminary filter 18 and the valve element 20 is limited only to the welding.

The edge part of the filter 17 has structure which crimps the edge part of the preliminary filter 18 and the inner gasket 19.

After caulking is completed, it is really a thing as an assembly which constitutes an obturation part. The gasket 24 is what fabricated insulators, such as polycarbonate, to ring shape, and when the assembly of the aforementioned obturation part is included in the cell case 26 and is crimped and obturated, it is performing the insulation between the cell case 26 and the filter 17.

[0044] The slit A is minced by the valve element 20 as an explosion proof valve which is an explosion-proof function means.

When generated by the gasified electrolysis solution, the bore B provided in the bore C and the preliminary filter 18 of the filter 17 is passed, and it has structure which makes the valve element 20 the cap 22 side.

[0045] Below, the current reduction function means by PTC element 21 is explained. When PTC

element 21 becomes specified temperature, it is an element for which resistance goes abruptly up. If the temperature of a cell rises and specified temperature is reached according to overcharge or big discharge current, for example, the current beyond the current value which is equivalent to discharge for 1 hour, a cell will prevent that it will be in an un-safe state thermally by resistance's rising and reducing current.

[0046]The current shutting off function means at the time of the inter-cell-pressure rise by welding the preliminary filter 18 and the valve element 20 is explained. The electrolysis solution gasified by generation of heat makes the valve element 20 the cap 22 side via the bore B provided in the bore C and the preliminary filter 18 of the filter 17. Under the present circumstances, when the pressure of gas exceeds the welding power of the preliminary filter 18 and the valve element 20, and welding separates, electric connection is intercepted and the operation as a current cutoff valve is performed.

[0047]The explosion-proof function means by the valve element 20 is explained. After the current shutting off function means by the preliminary filter 18 and the valve element 20 operates, the electrolysis solution gasified by generation of heat makes the valve element 20 the cap 22 side further. On the other hand, since the circumference is being fixed with the inner gasket 19, the filter 17, the gasket 24, and the cell case 26, the slit A provided in the valve element 20 with the pressure of gas is fractured, and the electrolysis solution gasified at the time escapes from the valve element 20 to the cap 22 side. It is emitted from the bore D of the cap 22 by this, that pressure is decompressed, and the gasified electrolysis solution prevents explosion of the cell itself by it.

[0048]Drawing 4 is a block diagram of the safety circuit with which the rechargeable lithium-ion battery of this invention is provided. In drawing 4, the plus pole for input and output to the exterior of the rechargeable battery 28 with which + is controlled by the safety circuit 27, and S are the minus poles of the safety circuit 27, and connect with the minus pole formed in the peripheral face or the bottom of the rechargeable battery 28 by the feed unit or battery-charger side. - It is the minus pole formed in the peripheral face or the bottom of the rechargeable battery 28.

[0049]The plus output of the rechargeable battery 28 is connected to the safety circuit 27 via the current shutting off function means 29 and PTC element 30 (equivalent to PTC element 21 in drawing 2) which are constituted by the preliminary filter 18 explained by drawing 2, and the valve element 20.

[0050]If the voltage between the output side of PTC element 30 and a switch terminal is in default value when it is in the state where the switch terminal was connected with the minus pole of the rechargeable battery 28 by the feed unit or battery-charger side, The voltage detection circuits 31 built in the obturation part make the current cutoff elements 32, such as FET, one, and enable charge from a battery charger. On the other hand, if the voltage between the output side of PTC element 30 and a switch terminal becomes higher than default value, the voltage detection circuits 31 will turn OFF the current cutoff elements 32, such as FET, and will protect the rechargeable battery 28 from a surcharge.

[0051]Although the safety circuit 27 performs the above operation, when using FET for the current cutoff element 32, even if FET is in the state of OFF, discharge of the rechargeable battery 28 is possible by the body diode effect through + pole. The capacitor 33 performs measure against static electricity between + pole and - pole, and prevention from malfunction by a noise.

[0052]With the voltage detection circuits 35 to which drawing 5 shows the modification of the safety circuit 27 shown in drawing 4 to, and added the thermo sensitive register 34, and the function which monitors the change in resistance by the temperature of the thermo sensitive register 34 was added. If the temperature of the rechargeable battery 28 comes outside stipulated ranges (0 ** - less than 60 **, etc.), the operation which turns OFF the current cutoff elements 32, such as FET, will be added.

[0053]Drawing 6 shows other modifications of the safety circuit 27 shown in drawing 4, abolishes

the conventional ring shape PTC element (equivalent to PTC element 21 in drawing 2), and inserts PTC element 36 between the positive terminal of a safety circuit, and the plus pole for external I/O.

[0054]Although the above explanation explained that the negative voltage given to the minus pole S of the safety circuit 27 was obtained from minus of a cell case via connection of the feed unit or battery charger with which a cell is equipped, it is also feasible to carry out direct continuation of the negative voltage for safety circuit 27 to a cell case. However, since the self-discharge loss by the consumed electric current of the safety circuit 27 when not using a cell poses a problem in this case, the measure corresponding to a mothball is needed.

[0055](Example 2) The case where the safety circuit 27 shown in drawing 4 is included in the obturation part of the rechargeable battery 28 is explained with reference to drawing 7 and drawing 8. Drawing 7 shows the sectional view of an obturation part, drawing 8 (a) shows the exploded perspective view of the enclosed regio oralis, drawing 8 (b) shows the decomposition sectional view of the enclosed regio oralis, and it has structure which differs in the portion from PTC element 21 to the minus pole 37 for safety circuits from the case of drawing 2.

[0056]In drawing 7 and drawing 8, the electrode of PTC element 21 carries out field contact with the flexible wiring board 38 which comprised polyimide material, and is connected to the safety circuit 27 through a through hole and wiring. E is a bore for the explosion-proof construction provided in the flexible wiring board 38.

The portion which is equivalent to the opening of an above-mentioned safety circuit board, and is easy to fracture with a pressure to the breaking mechanism of an above-mentioned safety circuit board, i.e., a printed circuit board, may be provided.

On the other hand, the minus pole 37 for safety circuits carries out field contact, and is connected to the flexible wiring board 38 through wiring in the safety circuit 27. Through the flexible wiring board 38, input output end + of the rechargeable battery 28 controlled by the safety circuit 27 is field contact, and becomes the plus pole 39 for controlling input and output of a rechargeable battery. Insulating materials, such as thermosetting adhesives; such as an epoxy system, and ABS plastics with which F insulates 41, coating of the waterproofness of the safety circuit 27 and electrolysis solution-proof nature and 42 insulate 40, and 45 insulate between the minus pole 37 for safety circuits and the plus poles 39 for controlling input and output of a rechargeable battery, and 44 are obturation board rings.

[0057](Example 3) As shown in drawing 6, when PTC element 36 has been arranged between the plus pole of a safety circuit, and the plus pole for external I/O, as shown in drawing 9, the plus pole 39a for controlling input and output of a rechargeable battery itself can consist of PTC elements. The composition of other portions is the same as that of drawing 7 and drawing 8.

[0058](Example 4) As the connection with the plus pole 39 for controlling input and output of a rechargeable battery and the flexible wiring board 38 in drawing 7 is shown in drawing 10, the plus pole 39 for controlling input and output of a rechargeable battery may be made to be connected to the parts on the flexible wiring board 38 by the spring materials 46, such as phosphor bronze. In this case, become possible to simplify the composition of a battery cap, and the flexible wiring board 38 bottom. Since it becomes the composition made [the valve element 20] to carry out field contact via PTC element 21 which meets on the minus pole 37 for safety circuits where the flexible wiring board 38 upper part meets, respectively, the whole obturation part can be constituted easily. 41 and 49 are thermosetting adhesives, such as an epoxy system.

[0059]The safety circuit 27 explained above can be made into IC package specification as shown in drawing 11. In drawing 11, 50 is a VOUT lead and a VDD (GND) lead and 51 a VIN (VSS) lead and 52 each lead 50, 51, and 52, In drawing 7, can arrange instead of the printed circuit board 38, and the portion G in contact with the minus pole 37 for safety circuits, PTC element 21, and the plus pole 39 for controlling input and output of a rechargeable battery is removed. It is what performed insulating coating treatment with electrolysis solution-proof materials, such as PBT (polybutylene

terephthalate), and an assembly becomes easy, when a printed circuit board becomes unnecessary and an obturation part is assembled. The space of the leads 50, 51, and 52 is equivalent to an above-mentioned cavity part, and serves as a passage of the gasified electrolysis solution which is emitted.

[0060]The minus pole 37 for safety circuits in drawing 7, It is necessary to have the bore I for contacting mechanically the plus pole 39 for controlling input and output of a rechargeable battery to two or more outgassing bores H for an explosion-proof construction from the surface of the minus pole 37 for safety circuits, as shown in drawing 12. In the plus pole 39 for controlling input and output of the rechargeable battery in this case. As shown in drawing 13, two or more larger outgassing bores J than two or more outgassing bores H of the minus pole 37 for safety circuits. Thermosetting adhesives, such as an epoxy system, are applied to the range K which does not start the bore I for making the plus pole 39 for controlling input and output of a rechargeable battery contact mechanically from the surface of the minus pole 37 for safety circuits via the minus pole 37 for safety circuits. After the minus pole 37 for safety circuits and the plus pole 39 for controlling input and output of a rechargeable battery apply thermosetting adhesives, such as an epoxy system, to metallic materials, such as nickel material by which hole processing was carried out beforehand, respectively, they can also be formed in one.

[0061](Example 5) Drawing 14 is drawing of longitudinal section of the important section of the rechargeable lithium-ion battery provided with the assembly obturation board of this example. The assembly obturation board 60 shown here is provided with the inside cap 61, the outer cap 65, and the printed circuit board 70 that attached the element 72.

[0062]An assembly obturation board welds [the PCT element 73 of the ring shape arranged on the undersurface of the printed circuit board 70, the valve element 74 which consists of metallic thin plates, and] the center section of the valve element 74 further, It has the filter 77 which has the bore 78 for letting the preliminary filter 75 and gas which have the bore 76 for letting gas pass pass, and the inner gasket 79. And the inner gasket 79 has prevented the electric interengagement in the edge part of the valve element 74 and the preliminary filter 75 by covering the portion covering the edge part of the valve element 74 from the edge part of the outer cap 65. The filter 77 is assembling the whole as an assembly obturation board of one by putting the edge part of the preliminary filter 75 and the inner gasket 79 in the edge part. The upper surface edge part of the filter 77 is having electric interengagement prevented by the inner gasket 79 with the edge part of the outer cap 65, the printed circuit board 70, PTC element 73, and the valve element 74.

[0063]Next, the above-mentioned printed circuit board 70 is explained in detail. While fixing in the center the element 72 which packed the electric circuit which constitutes the safety circuit which the printed circuit board 70 is what wired the flexible electric insulating plate, and is mentioned later, The inside cap 61 and the outer cap 65 are fixed with the adhesives 68 of electric insulation, for example, an epoxy resin, so that the element 72 may be covered. The printed circuit board 70 is carrying out two or more owners of the bore 71 for letting gas pass.

[0064]The inside cap 61 has the four bores 62 for letting gas pass, and has the insulating coating 63 for insulating with the outer cap 65 electrically in the outside surface. In order to form the hollow part 95 which lets gas pass between the inside caps 61, the outer cap 65 formed the bulged part 96 which made it bulge outside, and has formed the four bores 66 which let gas pass to this bulged part 96 further. The adhesives 69 insulated in those upper parts make the inside cap 61 and the outer cap 65 have intervened among both. Wiring is given to the printed circuit board so that the flange 64 of the inside cap 61 may be connected to the negative terminal of the printed circuit board 70 which connected the element 72 and the flange 67 and the PCT element 73 of the outer cap 65 may be connected to a positive terminal, respectively.

[0065]The opening of the cell case 90 is equipped with the assembly obturation board 60 constituted as mentioned above. Into the cell case 90, the group of electrode 91 spirally wound via the separator in the anode board and the negative electrode plate is inserted. equipping the edge

part of the assembly obturation board 60 with the gasket 94, and closing the upper bed part of the case 90 to these gasket parts, after welding the lead board 93 of one electrode of a group of electrode, for example, an anode, to the filter 77 of the assembly obturation board 60 -- the cell case 90 -- liquid -- it is sealed densely and airtightly. 92 shows the electric insulating plate. The negative electrode lead board (not shown) of the group of electrode 91 is welded to the bottom of the cell case. Therefore, the cell case 90 serves as the negative pole terminal of a cell.

[0066]When the cell case 90 is equipped with the assembly obturation board 60 as mentioned above, the outer cap 65, It is connected to the anode of the group of electrode 91 via the valve element 74 in contact with the printed circuit board 70, PTC element 73 in contact with this, and the element 73, the preliminary filter 75 joined in this valve element 74 and center section, and the filter 77, and works as a positive pole terminal.

[0067]Next, the safeguard shown in drawing 16 is explained. In drawing 16, 100 shows the rechargeable battery with which it was equipped with the assembly obturation board 60. 101 shows the switch which functions as a current shutting off function means which comprises a joined part of the preliminary filter 75 and the valve element 74 connected to the positive electrode lead of a cell. Aforementioned PTC element 73 is connected to this switch 101 in series. In the element 72 which packed the electric circuit, the voltage detection circuits 102, the thermo sensitive register 107, and the capacitor 104 which detect the thermal cutout 106 connected to PTC element 73 in series and the current cutoff element 103, and voltage, and control the current cutoff element 103 are incorporated.

[0068]And the positive terminal of the element 72 is connected to the outer cap 65. On the other hand, negative terminal S is connected to the inside cap 61, and this is connected to the negative pole terminal of a cell via the switch 105. Therefore, if this cell is set to a cell use device, the negative pole terminal by the side of the apparatus connected to the cell case which is a negative pole terminal of a cell will flow electrically with the inside cap 61. That is, the one [the switch 105] by setting a cell to apparatus.

[0069]As mentioned above, if one [the cell by which it was equipped with the assembly obturation board 60 is set to apparatus and / the switch 105], predetermined voltage is impressed between the output side of PTC element 73, and a switch terminal, and the voltage detection circuits 102 will make the current cutoff element 103 one, and will enable acceptance of the charging current from a battery charger. If the voltage of the cell 100 which appears in the voltage between the output side of PTC element 73 and a switch terminal becomes higher than default value, the voltage detection circuits 102 will turn OFF the current cutoff element 103, and will protect the cell 100 from overcharge current.

[0070]The safety circuit included in the element 72 is explained in more detail. The voltage detection circuits 102 detect the voltage of the cell 100, and the voltage of the current cutoff element 103, and control a current cutoff element. When the voltage of the cell 100 detected with the voltage detection circuits 102 is higher than the programmed voltage of a predetermined maximum, it is a surcharge, and it is overdischarge when the voltage of the cell 100 detected with the voltage detection circuits 102 is lower than the programmed voltage of a predetermined minimum. When the cell voltage detected exceeds predetermined upper limit voltage, or when less than predetermined lower limit voltage, the voltage detection circuits 102 turn OFF the current cutoff element 103, and intercept current. When the voltage between the input side of the current cutoff element 103 and output side which consist of field effect transistors (FET), for example is detected and it becomes higher than a predetermined programmed voltage, by a short circuit etc., the voltage detection circuits 102 detect that excessive current flowed, and turn OFF the current cutoff element 103, for example. The voltage detection circuits 102 turn OFF the current cutoff element 103, when the voltage of the thermo sensitive register 107 is detected and it separates from the range whose battery temperature the temperature of the cell 100 and the current cutoff element 103 is a stipulated range, and is 0 ** - 60 **. The thermal cutout 106 works as a safeguard

severed by the abnormal heat generation of the cell 100 or the current cutoff element 103.

[0071]The safety circuit included in the element 72 carries out the above work. If FET is used as the current cutoff element 103, also in the state of OFF, this is possible for discharge of the cell 100 through a plus pole by the body diode effect. The capacitor 104 was formed for the measure against static electricity between a plus pole and a minus pole, and prevents malfunction by a noise. If PTC element 73 becomes specified temperature, resistance will go abruptly up. If the temperature of a cell rises and PTC element 73 reaches specified temperature when overcharge current or big discharge current, for example, the current beyond the current value equivalent to 1 hour-rate discharge, flows, the resistance will go abruptly up and current will be reduced. A cell is prevented from being in an un-safe state thermally by this. This PTC element 73 is also incorporable in the element 72.

[0072]Next, work of an assembly obturation board when inter-cell-pressure power rises is explained. The inside of a cell serves as an elevated temperature in spite of work of the above safety circuits and a PTC element, and if the electrolysis solution which is mainly concerned with an organic solvent gasifies, gas will make the valve element 74 the printed circuit board side through the bore 78 of the filter 77, and the bore 76 of the preliminary filter 75. When gas pressure exceeds the welding power of the preliminary filter 75 and the valve element 74, a welding separates, and the electric connection between the preliminary filter 75 and the valve element 74 is intercepted. The electrical link between a cell, its charge circuit, and/or a discharge circuit is entirely severed by this. Thus, the preliminary filter 75 and the valve element 74 work as the switch which has a current shutting off function, i.e., a current shutting off function means.

[0073]Next, if gas pressure becomes still larger, the valve element 74 will be pressed further to the printed circuit board side. And if a value with gas pressure is exceeded, the valve element 74 will be fractured from the notch (not shown) provided in a part of the surface. For this reason, gas passes along the bore 71 of a printed circuit board from that breaking part, and is further emitted to the exterior through the bore 62 of the inside cap 61, the hollow part 95 between the inside cap 61 and the outer cap 65, and the bore 66 of the outer cap 65.

[0074]Under the present circumstances, since the hollow part 95 is formed between the inside cap 61 and the outer cap 65, even if the position of the bores 62 and 66 of both caps is not in agreement, the gas which passed the bore 62 reaches the bore 66 easily through the hollow part 95, and is emitted outside from there. If there is no hollow part 95, when the position of the bores 62 and 66 of both caps is not in agreement, the gas emitted so much at a stretch cannot pass through the narrow gap during both caps, but the inside of a cell will serve as overpressure and a risk of exploding will follow.

[0075]In this way, when an electrolysis solution gasifies by a cell becoming an elevated temperature etc. and inter-cell-pressure power rises unusually, If current is intercepted by the current shutting off function means of the preliminary filter 75 and the valve element 74 and a pressure rises further, the valve element 74 will fracture as an explosion-proof function means, and it will be emitted outside from the bore of the caps 61 and 65. Therefore, there is no risk of the cell itself exploding.

[0076](Example 6) Drawing 15 is drawing of longitudinal section of the important section of the assembly obturation board of this example. This assembly obturation board 80 has changed the structure of the inside cap 81 and the outer cap 85, and also does not have the assembly obturation board 60 of Example 5, and an essential difference. The inside cap 81 has pasted up the outer cap 85 on the printed circuit board 70 with the adhesives 88, respectively so that the flange 87 may contact the positive terminal of the printed circuit board 70, so that the flange 84 may contact the negative terminal of the printed circuit board 70. The inside cap 81 has the bore 82 for letting gas pass in the side upper part.

[0077]On the other hand, the outer cap 85 has the bore 86 for letting gas pass in a side lower part. And the outer cap 85 has formed the hollow part 97 between the inside caps 81 by bulging a top edge part outside. When this bulged part 98 sets a cell to apparatus, the terminal area of apparatus

can be equipped with it at a snap hook type. It is completely the same as that of Example 5 to have formed the insulating film 83 in the outside surface of the inside cap and to have made the insulation material 89 intervene among both caps.

[0078]Also in this composition, the gas which fractured the valve element 74 and went into the bore 82 of the inside cap 81 escapes from the bore 86 of the outer cap 85 easily from the hollow part 97, and is emitted to the exterior. The bore 86 for discharging the gas of the outer cap 85, It seems that a linear metallic member like a hair pin enters into the cavity part between inside caps from the bore of an outer cap, and electrically connects both caps, and a cell is not short-circuited since it is in a low rank from the bore 82 of the inside cap 81.

[0079]In the above-mentioned example, although the number of the bores for the degassing provided in the inside cap and the outer cap is four, respectively, the number of bores is what should be suitably chosen according to the size and cell.

[0080]Although it had composition which electrically connects the anode of a cell with an outer cap, it can also have composition which connects the anode of a cell with an inside cap.

[0081]Although the PTC element was inserted between the printed circuit board and the valve element as one part, it is also incorporable into the element 72 on a printed circuit board.

[0082]The material shown in each above-mentioned example is an example, and can be changed and used within limits which achieve a function.

[0083]In the above-mentioned example, although the example which applied this invention to the rechargeable lithium-ion battery was explained, it cannot be overemphasized that this invention is applicable also like other rechargeable batteries.

[0084]

[Effect of the Invention]As explained above, according to this invention, it controls not to become overcharge and overdischarge alone, While preventing the situation where the gas pressure in a rechargeable battery increases unusually, when the gas pressure in a rechargeable battery moreover turns into unusual high voltage, the rechargeable battery which can emit gas promptly and can prevent the burst of a cell beforehand can be obtained.

[0085]In this invention, it carries out with a gestalt which was explained above.

Therefore, the following technical problems made into the problem by the conventional packed type cell are solvable.

[0086]1) Since the packed type cell is the shape and the case of a design with which a feed unit can be equipped, it becomes a feed unit-oriented exclusive pack.

[0087]2) Since the battery pack is the shape and the case of a design with which a feed unit can be equipped, the battery charger was also set by the packed type cell, or it becomes a dedicated charger including the stowage of the feed unit.

[0088]3) The volume of the packed type cell which established the shape for equipping a safety circuit and a feed unit and a design, and terminal structure should become large at any cost compared with the volume of the cell stored in a packed type cell.

[0089]4) General consumers do not obtain rechargeable battery simple substances, such as a lithium ion. If the size of rechargeable batteries, such as a lithium ion, is specified beforehand, will become possible to carry out production supply of the rechargeable battery plentifully, without being caught by the shape of feed unit each, a design, the sale stage, and the amount of sale, and. Also in general consumers, if the apparatus by which the above-mentioned cell is applied is purchased, when required, the advantageous effect of becoming possible for the rechargeable battery of a complement to come to hand easily will be acquired.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention]In this invention, it is related with the cell which contained the safeguard in the sealed type rechargeable battery of a rechargeable lithium-ion battery etc.
Therefore, especially the electric circuit of a safeguard is miniaturized and it is related with the assembly obturation board for rechargeable batteries which built into the obturation circles of a cell the thing which carried out mounting arrangement, and the safeguard.

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PRIOR ART

[Description of the Prior Art] The demand as a power supply for a drive of small portable devices, such as a video camera, a cellular phone, and a personal computer, has expanded the rechargeable lithium-ion battery quickly from the place which has high energy density also in a sealed type rechargeable battery. This rechargeable lithium-ion battery needs a safeguard including the electric circuit as a safety circuit for protecting from overcharge, overdischarge, and an over-current. Then, it is usually included in a cell use device as a packed type cell which combined the electric circuit as a safety circuit with the cell.

[0003] The packed type cell using a rechargeable lithium-ion battery, It is composition like drawing 1 in which a mimetic diagram is shown, and the case which mounts 1 in the shape which can equip a feed unit with the cylindrical rechargeable lithium-ion batteries 2 and 3, and 4 are the safety circuits inserted between the terminals of the rechargeable lithium-ion batteries 2 and 3 and the case 1 in drawing 1.

[0004] The composition of the safety circuit 4 in the former is shown in drawing 17 as a block diagram, and the positive voltage from a battery charger, Charge of the rechargeable lithium-ion batteries 2 and 3 is performed by flowing into the minus side of a battery charger via the positive terminal 5, PTC element 6, the rechargeable lithium-ion batteries 3 and 2, FET7 and 8, the thermal cutout 9, and the terminal 10.

[0005] Discharge of the rechargeable lithium-ion batteries 2 and 3 is performed via plus of PTC element 6, the positive terminal 5, and apparatus and minus, the negative terminal 10, the thermal cutout 9, FET8, and 7. It is connected to the control circuit 13, and if the voltage detection circuits 11 and 12 which supervise cell voltage will turn OFF FET8, will carry out the function of the prevention from overcharge, if cell voltage becomes higher than default value, and they become lower than default value, they will turn OFF FET7, will carry out the function of overdischarge prevention, and will intercept current. When it is connected to the control circuit 13 and excessive current occurs by an external short circuit etc. between the negative terminals 10 from the positive terminal 5, the voltage detection circuits 14 which detect the voltage between the source drains of FET7 turn OFF FET7 and 8, and intercept current. The thermo sensitive register 15 monitors the temperature of a cell from the battery-charger or use device side via the terminal 16.

[0006] As mentioned above, mounting arrangement is carried out as the safety circuit 4 at a printed circuit board, and the function to prevent the surcharge of a cell simple substance, the function to prevent overdischarge, the interception function at the time of excessive current, the battery temperature monitor function, etc. comprise a conventional packed type cell inside the case 1.

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EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, according to this invention, it controls not to become overcharge and overdischarge alone, While preventing the situation where the gas pressure in a rechargeable battery increases unusually, when the gas pressure in a rechargeable battery moreover turns into unusual high voltage, the rechargeable battery which can emit gas promptly and can prevent the burst of a cell beforehand can be obtained.

[0085]In this invention, it carries out with a gestalt which was explained above.

Therefore, the following technical problems made into the problem by the conventional packed type cell are solvable.

[0086]1) Since the packed type cell is the shape and the case of a design with which a feed unit can be equipped, it becomes a feed unit-oriented exclusive pack.

[0087]2) Since the battery pack is the shape and the case of a design with which a feed unit can be equipped, the battery charger was also set by the packed type cell, or it becomes a dedicated charger including the stowage of the feed unit.

[0088]3) The volume of the packed type cell which established the shape for equipping a safety circuit and a feed unit and a design, and terminal structure should become large at any cost compared with the volume of the cell stored in a packed type cell.

[0089]4) General consumers do not obtain rechargeable battery simple substances, such as a lithium ion. If the size of rechargeable batteries, such as a lithium ion, is specified beforehand, will become possible to carry out production supply of the rechargeable battery plentifully, without being caught by the shape of feed unit each, a design, the sale stage, and the amount of sale, and. Also in general consumers, if the apparatus by which the above-mentioned cell is applied is purchased, when required, the advantageous effect of becoming possible for the rechargeable battery of a complement to come to hand easily will be acquired.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]If it was in the above conventional packed type cells, there was a problem that it explained below.

[0008]1) Since the shape and the design of the case 1 are formed so that it may be easy to equip a feed unit with a packed type cell, the case 1 becomes a thing for exclusive use corresponding to a feed unit in many cases.

[0009]2) Since the case 1 is the shape and the design with which a feed unit can be equipped, it is necessary to align a battery charger with the case 1, and the battery charger for exclusive use corresponding to a feed unit is needed.

[0010]3) It is necessary to establish the terminal structure made the shape and the design for equipping a safety circuit and a feed unit, and becomes very large compared with the volume of the rechargeable lithium-ion batteries 2 and 3 with which the volume resulting from these is stored.

[0011]4) General consumers cannot obtain rechargeable battery simple substances, such as a lithium ion, easily. Thus, the conventional packed type cell was lacking in flexibility.

[0012]Especially this invention has included the electric circuit which constitutes a safeguard in the inside of a cell, and an object of this invention is to provide the rechargeable battery with a safeguard which can treat itself like the conventional cell simple substance.

[0013]An object of this invention is to provide the rechargeable battery provided with the obturation board which can discharge gas to the exterior easily, when the inside of a cell becomes unusual high voltage and a valve element fractures.

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MEANS

[Means for Solving the Problem]In order to solve the above-mentioned problem, suppose a rechargeable battery of this invention that a safety circuit which has a current cutoff element is arranged in an obturation part. And like [between a cap and a current cutoff valve of an obturation part in the upper part of a rechargeable battery], Usually, by arranging a microminiaturized safety circuit, into a portion which cannot touch an electrolysis solution directly, the rechargeable battery itself which built in a safety circuit can be treated like the conventional cell simple substance at the time, and it can store a rechargeable battery easily to a cell storage room of a feed unit into it.

[0015]This invention improves an assembly obturation board with which an opening of a cell case which while accommodated a power generation element and serves as a polar terminal is equipped via a gasket. Namely, an inside cap and an outer cap with which an assembly obturation board by this invention was insulated electrically mutually, And consist of a metallic thin plate fractured by a predetermined pressure, and a valve element which has a current shutting off function means to sever electrical continuity in advance of a fracture is included, One side of said cap is pushed in said valve element, it is electrically connected with a polar electrode of another side of a power generation element, and both caps have a bore for discharging gas, respectively, and it has a hollow part which is open for free passage to said both bores among both caps.

[0016]Gas which was emitted so much at a stretch and fractured a valve element by existence of this hollow part shifts to a bore of an outer cap easily from a bore of an inside cap, and is emitted outside. A fear of a cell exploding by this can be lost.

[0017]

[Embodiment of the Invention]Like [between the cap and current cutoff valve of an obturation part which this invention is an upper part / of a cell /, i.e., plus pole, side, and are formed with the gasket etc. which fix a cap, a PTC element, an explosion proof valve, a current cutoff valve, and these], Usually, make current cutoff elements, such as voltage detection circuits and FET, the portion which cannot touch an electrolysis solution directly with basic constitution at the time, arrange the safety circuit which comprised electronic parts, such as a control circuit, a capacitor, resistance, and a fuse, and by this, The rechargeable battery which contained the safety circuit is treated like the conventional cell simple substance, and it can store easily to the cell storage room of a feed unit.

[0018]A safety circuit protects the safety circuit unit from the electrolysis solution of a cell itself [processing of waterproofness and **** acidity or alkalinity, i.e., coating treatment, the water which carried out closure processing and invaded from the outside, and], for example by an epoxy resin, polybutylene terephthalate resin, etc.

[0019]Provide an opening in a safety circuit board, or it is made for some safety circuit boards to fracture by the internal pressure rise of a cell, The electrolysis solution which invaded into the safety circuit unit, or the gasified electrolysis solution can be emitted out of a cell from the outgassing bore of a cap part through the opening of a safety circuit board, a cavity part, or a

breaking mechanism.

[0020]The electric connection between the plus pole of a cell and the plus output terminal to the exterior can be intercepted by arranging a thermal cutout to a safety circuit and blowing out a thermal cutout by generation of heat of a cell itself [current cutoff elements, such as FET, or].

[0021]The safety of a cell is securable by arranging a thermo sensitive register to a safety circuit, and specifying a charge temperature requirement.

[0022]It can connect with a safety circuit via a PTC element, and the trip of the PTC element can be carried out also by generation of heat of current cutoff elements, such as FET.

[0023]It replaces with a ring shape PTC element (equivalent to PTC21 in drawing 2), A PTC element can be arranged between the plus pole of a safety circuit, and an external I/O plus pole, and the trip of the PTC element can be carried out also with the time of the excessive current by the short circuit of a cell output, etc., the temperature of a cell, or the temperature of a safety circuit.

[0024]Consider the cap of an obturation part as 2 pole composition of the minus pole for safety circuits, and the plus pole for external I/O, and the minus pole of the peripheral face of a cell or the bottom and the minus pole for safety circuits until it is connected by the feed unit or battery-charger side, Since the consumed electric current of a safety circuit is not generated, the overdischarge protection feature of a cell can be made unnecessary. The safety circuit can usually microminiaturize and arrange into the portion which cannot touch an electrolysis solution directly together with the high-density-assembly art of mounting the high integration art of a semiconductor, the miniaturization technology of parts, and these, at the time like [between the cap and current cutoff valve in the obturation part in the upper part of a cell].

[0025]The external short circuit which provides a level difference in the minus pole for safety circuits and the plus pole for external I/O in a cap, and happens at the time of the handling of a cell can be made hard to generate.

[0026]The minus pole for safety circuits and the plus pole for external I/O in a cap, It can assemble via the thing electrically pasted up with thermosetting adhesives, such as insulating adhesives, for example, an epoxy system etc., or an electric insulating material, and the immobilization and the insulation between the minus pole for safety circuits of intensity reservation of the whole cap and a cap and the plus pole for external I/O can be made good.

[0027]The electric short circuit in the circumference of the outgassing bore of a cap part can be made hard to enlarge the path of the outgassing bore by the side of the plus pole for external I/O, and to generate to the path of the outgassing bore of the minus pole for safety circuits in a cap.

[0028]The cell case which serves as the terminal of one polarity [rechargeable battery / of the desirable composition by this invention], And the assembly obturation board with which the opening of the cell case was equipped via the gasket is provided, and the printed circuit board incorporating the electric circuit containing the voltage detection circuits with which said assembly obturation board detects the voltage of the current cutoff element and cell which were connected to the cell in series, and controls said current cutoff element is included. This printed circuit board has a bore for discharging gas, and, moreover, the outer cap connected to the polar terminal area from which a printed circuit board differs, respectively, and the inside cap are attached on the printed circuit board.

[0029]The valve element which consists of a metallic thin plate which an assembly obturation board is further arranged on the cell inside from a printed circuit board, and is fractured by a predetermined pressure, And the electrical connecting means which pushes the terminal area connected to one cap of said printed circuit board in said valve element, and is electrically connected with the polar electrode of another side of a power generation element is included. And it has a hollow part which an outer cap and an inside cap have a bore for discharging gas, respectively, and is open for free passage to said both bores among both caps, and said valve element is constituted so that electrical continuity may be severed in advance of a fracture. Said electric circuit is connected to said one polar terminal via the cap of another side, when a cell is set to

apparatus.

[0030]The 1st feature of this composition is having a hollow part which is open for free passage to the bore of both caps between an outer cap and an inside cap. This hollow part serves for the gas by which the inside of a cell became unusual high voltage, and fractured the valve element as mentioned above to make shift to the bore of an outer cap easily from the bore of an inside cap. If it is in the position to which the bore provided in both caps corresponds, respectively, it is not necessary to provide the aforementioned hollow part specially. In order to have such composition, alignment is needed at the time of an assembly of a cap, and it becomes complicated on work. When the position of the bore of both caps is in agreement, a linear metallic member like a hair pin enters into both bore, and electrically connects both caps, and there is a possibility that the inconvenience of short-circuiting a cell may arise. According to this invention, the special management for coinciding a bore at the time of an obturation board assembly is also unnecessary, and, moreover, anxiety of the short circuit by a line metallic member can be lessened.

[0031]As for an outer cap and an inside cap, it is preferred to be formed inside the bulged part which has said bore for discharging gas, respectively on the side, and said hollow part provided in the side of the outer cap. By this composition, the space in an inside cap is utilizable for the maximum.

[0032]As for an outer cap, it is preferred to provide a bulged part in the upper surface edge part. When this bulged part sets a cell to apparatus, the terminal area of apparatus can be equipped with it at a snap hook type.

[0033]As for the bore for discharging the gas of an outer cap, in the composition which provided the bulged part in the upper surface edge part of the outer cap, providing in a low rank is more preferred than the bore of an inside cap. According to this composition, for example, a linear metallic member like a hair pin enters into the cavity part between inside caps from the bore of an outer cap, and electrically connects both caps, and what short-circuits a cell is lost.

[0034]As for the electric circuit included in said printed circuit board, it is preferred to have a function which intercepts the input of the over-current to a cell, the output of the over-current from a cell, or input and output of an over-current. For example, it constitutes so that a current cutoff element may be turned off, when said voltage detection circuits detect the voltage between the input side of said current cutoff element, and an output side and the voltage detected exceeds predetermined voltage.

[0035]As for said electric circuit, it is preferred to constitute so that said current cutoff element may be turned off, when it has a thermometric element and the temperature detected separates from a predetermined temperature requirement.

[0036]As for said electric circuit, it is preferred that the thermal cutout connected with the cell at series is included.

[0037]As for said electrical connecting means, it is preferred that a PTC element is included further. This PTC element can also be included in the electric circuit included in said printed circuit board instead of including in this electrical connecting means.

[0038]Still more preferably said electrical connecting means, It is welded by said valve element in a center section, and the preliminary filter electrically insulated in the edge part is included, Said preliminary filter has a male bore in gas, and the welding of said preliminary filter and a valve element is constituted so that it may work as a current shutting off function means which will separate if gas pressure exceeds a predetermined value.

[0039]The terminal which carries out the mold of the electric circuit part containing the voltage detection circuits which detect the voltage of the current cutoff element and cell which replaced with said printed circuit board and were connected to the cell in series, and control said current cutoff element like IC, unifies, and is equivalent to the terminal area of said printed circuit board is provided, The package which provided the cavity part between this terminal can be arranged.

[0040]Since the space which incorporates the safety circuit of a cell into the inside cap of an

assembly obturation board is securable according to this invention, like before, It is not necessary to consider it as the battery pack which suits only the specific cell use device which combined the safety circuit besides the cell, and the independent cell which contained the safety circuit can be provided.

[Translation done.]

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EXAMPLE

[Example] Hereafter, the example of this invention is described with reference to drawing 16 from drawing 2.

[0042](Example 1) Drawing 2 shows the sectional view of the obturation part of a cylindrical rechargeable lithium-ion battery, drawing 3 (a) shows the exploded perspective view of the enclosed regio oralis, and drawing 3 (b) shows the decomposition sectional view of the enclosed regio oralis. This obturation part has an explosion proof valve which is an explosion-proof function means when the PTC element which is a current reduction function means at the time of cell generation of heat, the current cutoff valve which is the current shutting off function means at the time of an inter-cell-pressure rise, and inter cell pressure go up further, It comprises the filter 17, the preliminary filter 18, the inner gasket 19, the valve element 20, PTC element 21, the cap 22, the obturation board ring 23, and the gasket 24. Usually, the current from an anode is connected to the filter 17 which has the bore C via the lead board 25, subsequently field contact of the time is carried out with this, and it leads to the preliminary filter 18 which has the bore B. It is led to the cap 22 on which the preliminary filter 18 and the valve element 20 have the bore D through PTC element 21 of the ring shape which the current of the anode passed along the valve element 20, and carried out field contact with this since the center section was joined by welding.

[0043] The cap 22, PTC element 21, and the valve element 20 are unified by the inner gasket 19 of ring shape.

Since this inner gasket 19 fabricates insulators, such as polycarbonate, the electric connection between the preliminary filter 18 and the valve element 20 is limited only to the welding.

The edge part of the filter 17 has structure which crimps the edge part of the preliminary filter 18 and the inner gasket 19.

After caulking is completed, it is really a thing as an assembly which constitutes an obturation part. The gasket 24 is what fabricated insulators, such as polycarbonate, to ring shape, and when the assembly of the aforementioned obturation part is included in the cell case 26 and is crimped and obturated, it is performing the insulation between the cell case 26 and the filter 17.

[0044] The slit A is minced by the valve element 20 as an explosion proof valve which is an explosion-proof function means.

When generated by the gasified electrolysis solution, the bore B provided in the bore C and the preliminary filter 18 of the filter 17 is passed, and it has structure which makes the valve element 20 the cap 22 side.

[0045] Below, the current reduction function means by PTC element 21 is explained. When PTC element 21 becomes specified temperature, it is an element for which resistance goes abruptly up. If the temperature of a cell rises and specified temperature is reached according to overcharge or big discharge current, for example, the current beyond the current value which is equivalent to discharge for 1 hour, a cell will prevent that it will be in an un-safe state thermally by resistance's

rising and reducing current.

[0046]The current shutting off function means at the time of the inter-cell-pressure rise by welding the preliminary filter 18 and the valve element 20 is explained. The electrolysis solution gasified by generation of heat makes the valve element 20 the cap 22 side via the bore B provided in the bore C and the preliminary filter 18 of the filter 17. Under the present circumstances, when the pressure of gas exceeds the welding power of the preliminary filter 18 and the valve element 20, and welding separates, electric connection is intercepted and the operation as a current cutoff valve is performed.

[0047]The explosion-proof function means by the valve element 20 is explained. After the current shutting off function means by the preliminary filter 18 and the valve element 20 operates, the electrolysis solution gasified by generation of heat makes the valve element 20 the cap 22 side further. On the other hand, since the circumference is being fixed with the inner gasket 19, the filter 17, the gasket 24, and the cell case 26, the slit A provided in the valve element 20 with the pressure of gas is fractured, and the electrolysis solution gasified at the time escapes from the valve element 20 to the cap 22 side. It is emitted from the bore D of the cap 22 by this, that pressure is decompressed, and the gasified electrolysis solution prevents explosion of the cell itself by it.

[0048]Drawing 4 is a block diagram of the safety circuit with which the rechargeable lithium-ion battery of this invention is provided. In drawing 4, the plus pole for input and output to the exterior of the rechargeable battery 28 with which + is controlled by the safety circuit 27, and S are the minus poles of the safety circuit 27, and connect with the minus pole formed in the peripheral face or the bottom of the rechargeable battery 28 by the feed unit or battery-charger side. - It is the minus pole formed in the peripheral face or the bottom of the rechargeable battery 28.

[0049]The plus output of the rechargeable battery 28 is connected to the safety circuit 27 via the current shutting off function means 29 and PTC element 30 (equivalent to PTC element 21 in drawing 2) which are constituted by the preliminary filter 18 explained by drawing 2, and the valve element 20.

[0050]If the voltage between the output side of PTC element 30 and a switch terminal is in default value when it is in the state where the switch terminal was connected with the minus pole of the rechargeable battery 28 by the feed unit or battery-charger side, The voltage detection circuits 31 built in the obturation part make the current cutoff elements 32, such as FET, one, and enable charge from a battery charger. On the other hand, if the voltage between the output side of PTC element 30 and a switch terminal becomes higher than default value, the voltage detection circuits 31 will turn OFF the current cutoff elements 32, such as FET, and will protect the rechargeable battery 28 from a surcharge.

[0051]Although the safety circuit 27 performs the above operation, when using FET for the current cutoff element 32, even if FET is in the state of OFF, discharge of the rechargeable battery 28 is possible by the body diode effect through + pole. The capacitor 33 performs measure against static electricity between + pole and - pole, and prevention from malfunction by a noise.

[0052]With the voltage detection circuits 35 to which drawing 5 shows the modification of the safety circuit 27 shown in drawing 4 to, and added the thermo sensitive register 34, and the function which monitors the change in resistance by the temperature of the thermo sensitive register 34 was added. If the temperature of the rechargeable battery 28 comes outside stipulated ranges (0 ** - less than 60 **, etc.), the operation which turns OFF the current cutoff elements 32, such as FET, will be added.

[0053]Drawing 6 shows other modifications of the safety circuit 27 shown in drawing 4, abolishes the conventional ring shape PTC element (equivalent to PTC element 21 in drawing 2), and inserts PTC element 36 between the positive terminal of a safety circuit, and the plus pole for external I/O.

[0054]Although the above explanation explained that the negative voltage given to the minus pole S

of the safety circuit 27 was obtained from minus of a cell case via connection of the feed unit or battery charger with which a cell is equipped, it is also feasible to carry out direct continuation of the negative voltage for safety circuit 27 to a cell case. However, since the self-discharge loss by the consumed electric current of the safety circuit 27 when not using a cell poses a problem in this case, the measure corresponding to a mothball is needed.

[0055](Example 2) The case where the safety circuit 27 shown in drawing 4 is included in the obturation part of the rechargeable battery 28 is explained with reference to drawing 7 and drawing 8. Drawing 7 shows the sectional view of an obturation part, drawing 8 (a) shows the exploded perspective view of the enclosed regio oralis, drawing 8 (b) shows the decomposition sectional view of the enclosed regio oralis, and it has structure which differs in the portion from PTC element 21 to the minus pole 37 for safety circuits from the case of drawing 2.

[0056]In drawing 7 and drawing 8, the electrode of PTC element 21 carries out field contact with the flexible wiring board 38 which comprised polyimide material, and is connected to the safety circuit 27 through a through hole and wiring. E is a bore for the explosion-proof construction provided in the flexible wiring board 38.

The portion which is equivalent to the opening of an above-mentioned safety circuit board, and is easy to fracture with a pressure to the breaking mechanism of an above-mentioned safety circuit board, i.e., a printed circuit board, may be provided.

On the other hand, the minus pole 37 for safety circuits carries out field contact, and is connected to the flexible wiring board 38 through wiring in the safety circuit 27. Through the flexible wiring board 38, input output end + of the rechargeable battery 28 controlled by the safety circuit 27 is field contact, and becomes the plus pole 39 for controlling input and output of a rechargeable battery. Insulating materials, such as thermosetting adhesives, such as an epoxy system, and ABS plastics with which F insulates 41, coating of the waterproofness of the safety circuit 27 and electrolysis solution-proof nature and 42 insulate 40, and 45 insulate between the minus pole 37 for safety circuits and the plus poles 39 for controlling input and output of a rechargeable battery, and 44 are obturation board rings.

[0057](Example 3) As shown in drawing 6, when PTC element 36 has been arranged between the plus pole of a safety circuit, and the plus pole for external I/O, as shown in drawing 9, the plus pole 39a for controlling input and output of a rechargeable battery itself can consist of PTC elements. The composition of other portions is the same as that of drawing 7 and drawing 8.

[0058](Example 4) As the connection with the plus pole 39 for controlling input and output of a rechargeable battery and the flexible wiring board 38 in drawing 7 is shown in drawing 10, the plus pole 39 for controlling input and output of a rechargeable battery may be made to be connected to the parts on the flexible wiring board 38 by the spring materials 46, such as phosphor bronze. In this case, become possible to simplify the composition of a battery cap, and the flexible wiring board 38 bottom. Since it becomes the composition made [the valve element 20] to carry out field contact via PTC element 21 which meets on the minus pole 37 for safety circuits where the flexible wiring board 38 upper part meets, respectively, the whole obturation part can be constituted easily. 41 and 49 are thermosetting adhesives, such as an epoxy system.

[0059]The safety circuit 27 explained above can be made into IC package specification as shown in drawing 11. In drawing 11, 50 is a VOUT lead and a VDD (GND) lead and 51 a VIN (VSS) lead and 52 each lead 50, 51, and 52, In drawing 7, can arrange instead of the printed circuit board 38, and the portion G in contact with the minus pole 37 for safety circuits, PTC element 21, and the plus pole 39 for controlling input and output of a rechargeable battery is removed. It is what performed insulating coating treatment with electrolysis solution-proof materials, such as PBT (polybutylene terephthalate), and an assembly becomes easy, when a printed circuit board becomes unnecessary and an obturation part is assembled. The space of the leads 50, 51, and 52 is equivalent to an above-mentioned cavity part, and serves as a passage of the gasified electrolysis solution which is emitted.

[0060]The minus pole 37 for safety circuits in drawing 7, It is necessary to have the bore I for contacting mechanically the plus pole 39 for controlling input and output of a rechargeable battery to two or more outgassing bores H for an explosion-proof construction from the surface of the minus pole 37 for safety circuits, as shown in drawing 12. In the plus pole 39 for controlling input and output of the rechargeable battery in this case. As shown in drawing 13, two or more larger outgassing bores J than two or more outgassing bores H of the minus pole 37 for safety circuits. Thermosetting adhesives, such as an epoxy system, are applied to the range K which does not start the bore I for making the plus pole 39 for controlling input and output of a rechargeable battery contact mechanically from the surface of the minus pole 37 for safety circuits via the minus pole 37 for safety circuits. After the minus pole 37 for safety circuits and the plus pole 39 for controlling input and output of a rechargeable battery apply thermosetting adhesives, such as an epoxy system, to metallic materials, such as nickel material by which hole processing was carried out beforehand, respectively, they can also be formed in one.

[0061](Example 5) Drawing 14 is drawing of longitudinal section of the important section of the rechargeable lithium-ion battery provided with the assembly obturation board of this example. The assembly obturation board 60 shown here is provided with the inside cap 61, the outer cap 65, and the printed circuit board 70 that attached the element 72.

[0062]An assembly obturation board welds [the PCT element 73 of the ring shape arranged on the undersurface of the printed circuit board 70, the valve element 74 which consists of metallic thin plates, and] the center section of the valve element 74 further, It has the filter 77 which has the bore 78 for letting the preliminary filter 75 and gas which have the bore 76 for letting gas pass pass, and the inner gasket 79. And the inner gasket 79 has prevented the electric interengagement in the edge part of the valve element 74 and the preliminary filter 75 by covering the portion covering the edge part of the valve element 74 from the edge part of the outer cap 65. The filter 77 is assembling the whole as an assembly obturation board of one by putting the edge part of the preliminary filter 75 and the inner gasket 79 in the edge part. The upper surface edge part of the filter 77 is having electric interengagement prevented by the inner gasket 79 with the edge part of the outer cap 65, the printed circuit board 70, PTC element 73, and the valve element 74.

[0063]Next, the above-mentioned printed circuit board 70 is explained in detail. While fixing in the center the element 72 which packed the electric circuit which constitutes the safety circuit which the printed circuit board 70 is what wired the flexible electric insulating plate, and is mentioned later, The inside cap 61 and the outer cap 65 are fixed with the adhesives 68 of electric insulation, for example, an epoxy resin, so that the element 72 may be covered. The printed circuit board 70 is carrying out two or more owners of the bore 71 for letting gas pass.

[0064]The inside cap 61 has the four bores 62 for letting gas pass, and has the insulating coating 63 for insulating with the outer cap 65 electrically in the outside surface. In order to form the hollow part 95 which lets gas pass between the inside caps 61, the outer cap 65 formed the bulged part 96 which made it bulge outside, and has formed the four bores 66 which let gas pass to this bulged part 96 further. The adhesives 69 insulated in those upper parts make the inside cap 61 and the outer cap 65 have intervened among both. Wiring is given to the printed circuit board so that the flange 64 of the inside cap 61 may be connected to the negative terminal of the printed circuit board 70 which connected the element 72 and the flange 67 and the PCT element 73 of the outer cap 65 may be connected to a positive terminal, respectively.

[0065]The opening of the cell case 90 is equipped with the assembly obturation board 60 constituted as mentioned above. Into the cell case 90, the group of electrode 91 spirally wound via the separator in the anode board and the negative electrode plate is inserted. equipping the edge part of the assembly obturation board 60 with the gasket 94, and closing the upper bed part of the case 90 to these gasket parts, after welding the lead board 93 of one electrode of a group of electrode, for example, an anode, to the filter 77 of the assembly obturation board 60 -- the cell case 90 -- liquid -- it is sealed densely and airtightly. 92 shows the electric insulating plate. The

negative electrode lead board (not shown) of the group of electrode 91 is welded to the bottom of the cell case. Therefore, the cell case 90 serves as the negative pole terminal of a cell.

[0066]When the cell case 90 is equipped with the assembly obturation board 60 as mentioned above, the outer cap 65, It is connected to the anode of the group of electrode 91 via the valve element 74 in contact with the printed circuit board 70, PTC element 73 in contact with this, and the element 73, the preliminary filter 75 joined in this valve element 74 and center section, and the filter 77, and works as a positive pole terminal.

[0067]Next, the safeguard shown in drawing 16 is explained. In drawing 16, 100 shows the rechargeable battery with which it was equipped with the assembly obturation board 60. 101 shows the switch which functions as a current shutting off function means which comprises a joined part of the preliminary filter 75 and the valve element 74 connected to the positive electrode lead of a cell. Aforementioned PTC element 73 is connected to this switch 101 in series. In the element 72 which packed the electric circuit, the voltage detection circuits 102, the thermo sensitive register 107, and the capacitor 104 which detect the thermal cutout 106 connected to PTC element 73 in series and the current cutoff element 103, and voltage, and control the current cutoff element 103 are incorporated.

[0068]And the positive terminal of the element 72 is connected to the outer cap 65. On the other hand, negative terminal S is connected to the inside cap 61, and this is connected to the negative pole terminal of a cell via the switch 105. Therefore, if this cell is set to a cell use device, the negative pole terminal by the side of the apparatus connected to the cell case which is a negative pole terminal of a cell will flow electrically with the inside cap 61. That is, the one [the switch 105] by setting a cell to apparatus.

[0069]As mentioned above, if one [the cell by which it was equipped with the assembly obturation board 60 is set to apparatus and / the switch 105], predetermined voltage is impressed between the output side of PTC element 73, and a switch terminal, and the voltage detection circuits 102 will make the current cutoff element 103 one, and will enable acceptance of the charging current from a battery charger. If the voltage of the cell 100 which appears in the voltage between the output side of PTC element 73 and a switch terminal becomes higher than default value, the voltage detection circuits 102 will turn OFF the current cutoff element 103, and will protect the cell 100 from overcharge current.

[0070]The safety circuit included in the element 72 is explained in more detail. The voltage detection circuits 102 detect the voltage of the cell 100, and the voltage of the current cutoff element 103, and control a current cutoff element. When the voltage of the cell 100 detected with the voltage detection circuits 102 is higher than the programmed voltage of a predetermined maximum, it is a surcharge, and it is overdischarge when the voltage of the cell 100 detected with the voltage detection circuits 102 is lower than the programmed voltage of a predetermined minimum. When the cell voltage detected exceeds predetermined upper limit voltage, or when less than predetermined lower limit voltage, the voltage detection circuits 102 turn OFF the current cutoff element 103, and intercept current. When the voltage between the input side of the current cutoff element 103 and output side which consist of field effect transistors (FET), for example is detected and it becomes higher than a predetermined programmed voltage, by a short circuit etc., the voltage detection circuits 102 detect that excessive current flowed, and turn OFF the current cutoff element 103, for example. The voltage detection circuits 102 turn OFF the current cutoff element 103, when the voltage of the thermo sensitive register 107 is detected and it separates from the range whose battery temperature the temperature of the cell 100 and the current cutoff element 103 is a stipulated range, and is 0 ** - 60 **. The thermal cutout 106 works as a safeguard severed by the abnormal heat generation of the cell 100 or the current cutoff element 103.

[0071]The safety circuit included in the element 72 carries out the above work. If FET is used as the current cutoff element 103, also in the state of OFF, this is possible for discharge of the cell 100 through a plus pole by the body diode effect. The capacitor 104 was formed for the measure

against static electricity between a plus pole and a minus pole, and prevents malfunction by a noise. If PTC element 73 becomes specified temperature, resistance will go abruptly up. If the temperature of a cell rises and PTC element 73 reaches specified temperature when overcharge current or big discharge current, for example, the current beyond the current value equivalent to 1 hour-rate discharge, flows, the resistance will go abruptly up and current will be reduced. A cell is prevented from being in an un-safe state thermally by this. This PTC element 73 is also incorporable in the element 72.

[0072]Next, work of an assembly obturation board when inter-cell-pressure power rises is explained. The inside of a cell serves as an elevated temperature in spite of work of the above safety circuits and a PTC element, and if the electrolysis solution which is mainly concerned with an organic solvent gasifies, gas will make the valve element 74 the printed circuit board side through the bore 78 of the filter 77, and the bore 76 of the preliminary filter 75. When gas pressure exceeds the welding power of the preliminary filter 75 and the valve element 74, a welding separates, and the electric connection between the preliminary filter 75 and the valve element 74 is intercepted. The electrical link between a cell, its charge circuit, and/or a discharge circuit is entirely severed by this. Thus, the preliminary filter 75 and the valve element 74 work as the switch which has a current shutting off function, i.e., a current shutting off function means.

[0073]Next, if gas pressure becomes still larger, the valve element 74 will be pressed further to the printed circuit board side. And if a value with gas pressure is exceeded, the valve element 74 will be fractured from the notch (not shown) provided in a part of the surface. For this reason, gas passes along the bore 71 of a printed circuit board from that breaking part, and is further emitted to the exterior through the bore 62 of the inside cap 61, the hollow part 95 between the inside cap 61 and the outer cap 65, and the bore 66 of the outer cap 65.

[0074]Under the present circumstances, since the hollow part 95 is formed between the inside cap 61 and the outer cap 65, even if the position of the bores 62 and 66 of both caps is not in agreement, the gas which passed the bore 62 reaches the bore 66 easily through the hollow part 95, and is emitted outside from there. If there is no hollow part 95, when the position of the bores 62 and 66 of both caps is not in agreement, the gas emitted so much at a stretch cannot pass through the narrow gap during both caps, but the inside of a cell will serve as overpressure and a risk of exploding will follow.

[0075]In this way, when an electrolysis solution gasifies by a cell becoming an elevated temperature etc. and inter-cell-pressure power rises unusually, If current is intercepted by the current shutting off function means of the preliminary filter 75 and the valve element 74 and a pressure rises further, the valve element 74 will fracture as an explosion-proof function means, and it will be emitted outside from the bore of the caps 61 and 65. Therefore, there is no risk of the cell itself exploding.

[0076](Example 6) Drawing 15 is drawing of longitudinal section of the important section of the assembly obturation board of this example. This assembly obturation board 80 has changed the structure of the inside cap 81 and the outer cap 85, and also does not have the assembly obturation board 60 of Example 5, and an essential difference. The inside cap 81 has pasted up the outer cap 85 on the printed circuit board 70 with the adhesives 88, respectively so that the flange 87 may contact the positive terminal of the printed circuit board 70, so that the flange 84 may contact the negative terminal of the printed circuit board 70. The inside cap 81 has the bore 82 for letting gas pass in the side upper part.

[0077]On the other hand, the outer cap 85 has the bore 86 for letting gas pass in a side lower part. And the outer cap 85 has formed the hollow part 97 between the inside caps 81 by bulging a top edge part outside. When this bulged part 98 sets a cell to apparatus, the terminal area of apparatus can be equipped with it at a snap hook type. It is completely the same as that of Example 5 to have formed the insulating film 83 in the outside surface of the inside cap and to have made the insulation material 89 intervene among both caps.

[0078]Also in this composition, the gas which fractured the valve element 74 and went into the bore

82 of the inside cap 81 escapes from the bore 86 of the outer cap 85 easily from the hollow part 97, and is emitted to the exterior. The bore 86 for discharging the gas of the outer cap 85, It seems that a linear metallic member like a hair pin enters into the cavity part between inside caps from the bore of an outer cap, and electrically connects both caps, and a cell is not short-circuited since it is in a low rank from the bore 82 of the inside cap 81.

[0079]In the above-mentioned example, although the number of the bores for the degassing provided in the inside cap and the outer cap is four, respectively, the number of bores is what should be suitably chosen according to the size and cell.

[0080]Although it had composition which electrically connects the anode of a cell with an outer cap, it can also have composition which connects the anode of a cell with an inside cap.

[0081]Although the PTC element was inserted between the printed circuit board and the valve element as one part, it is also incorporable into the element 72 on a printed circuit board.

[0082]The material shown in each above-mentioned example is an example, and can be changed and used within limits which achieve a function.

[0083]In the above-mentioned example, although the example which applied this invention to the rechargeable lithium-ion battery was explained, it cannot be overemphasized that this invention is applicable also like other rechargeable batteries.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The mimetic diagram of a packed type rechargeable lithium-ion battery

[Drawing 2]The sectional view of the obturation part of the cylindrical rechargeable lithium-ion battery in Example 1 of this invention

[Drawing 3](a) The exploded perspective view of the enclosed regio oralis

(b) The decomposition sectional view of the enclosed regio oralis

[Drawing 4]The block diagram of the safety circuit in Example 1 of this invention

[Drawing 5]The block diagram showing modification of the safety circuit

[Drawing 6]The block diagram showing other modification of the safety circuit

[Drawing 7]The sectional view of the obturation part in Example 2 incorporating the safety circuit shown in drawing 4

[Drawing 8](a) The exploded perspective view of the enclosed regio oralis

(b) The decomposition sectional view of the enclosed regio oralis

[Drawing 9]The sectional view of the obturation part in Example 3

[Drawing 10]The sectional view of the obturation part in Example 4

[Drawing 11](a) The front view of the safety circuit made into package specification

(b) The side view of the safety circuit

(c) The exploded perspective view of the safety circuit

[Drawing 12](a) The front view of the minus pole for safety circuits

(b) **--**' line sectional view

[Drawing 13](a) The top view of the plus pole for controlling input and output of a rechargeable battery

(b) **--**' line sectional view

[Drawing 14]Drawing of longitudinal section of the important section of the rechargeable lithium-ion battery provided with the assembly obturation board in Example 5

[Drawing 15]Drawing of longitudinal section of the important section of the assembly obturation board in Example 6

[Drawing 16]The figure showing the electric circuit containing the safeguard incorporated into the cell

[Drawing 17]The block diagram of the conventional safety circuit in a packed type rechargeable lithium-ion battery

[Description of Notations]

17 Filter

18 Preliminary filter

19 Inner gasket

20 Valve element

21 PTC element

22 Cap
27 Safety circuit
28 Rechargeable battery
32 Current cutoff element
34 Thermo sensitive register
37 The minus pole for safety circuits
38 Flexible wiring board
39 39a Plus pole for controlling input and output
41, 42, and 49 Thermosetting adhesive
60 and 80 Assembly obturation board
61 and 81 Inside cap
62 and 82 Bore
63 and 83 Insulating film
64 and 84 Flange
65, 85 outer caps
66 and 86 Bore
67 and 87 Flange
68, 69, 88, and 89 Adhesives
70 Printed circuit board
71 Bore
72 Element
73 PTC element
74 Valve element
75 Preliminary filter
76 Bore
77 Filter
78 Bore
79 Inner gasket
90 Cell case
91 Group of electrode
92 Electric insulating plate
93 Positive electrode lead board
94 Gasket
95 and 97 Hollow part
96 and 98 Bulged part
100 Cell
101 Switch
102 Voltage detection circuits
103 Current cutoff element
104 Capacitor
105 Switch
106 Thermal cutout
107 Thermo sensitive register
A Slit
B, C, D, E, H, and J Bore

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* NOTICES *

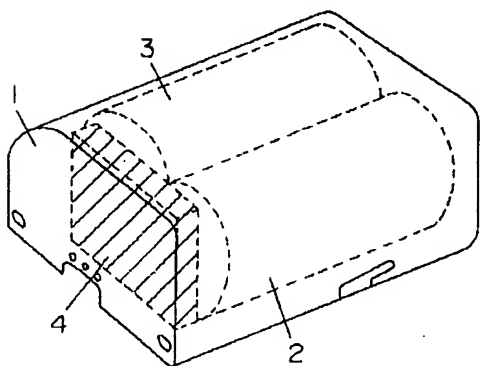
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DRAWINGS

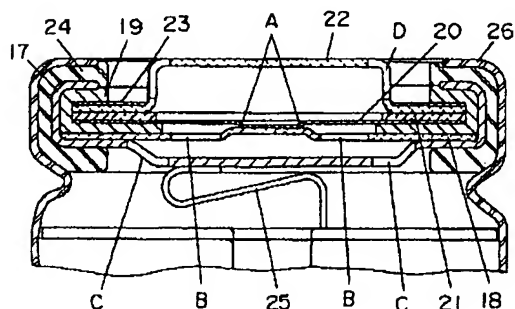
[Drawing 1]

- 1---筐体
2,3---リチウムイオン二次電池
4---安全回路

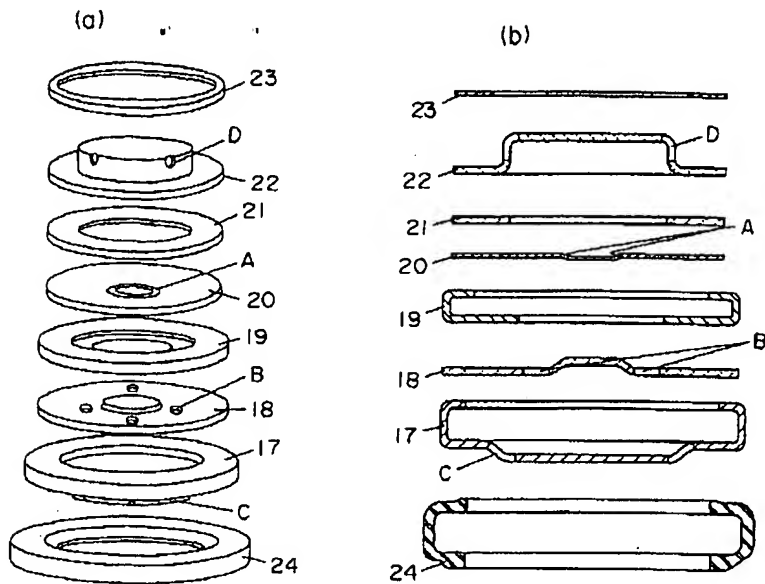


[Drawing 2]

- 17---フィルター
18---サブフィルター
19---インナーガasket
20---弁体
21---PTC素子
22---キャップ
23---封口板リング
24---ガスケット

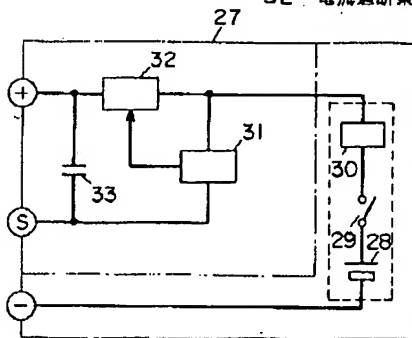


[Drawing 3]



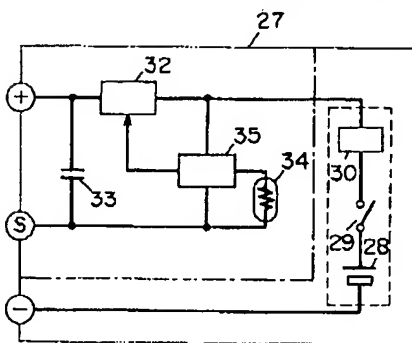
[Drawing 4]

27 --- 安全回路
 28 --- 二次電池
 30 --- PTC素子
 32 --- 電流遮断素子

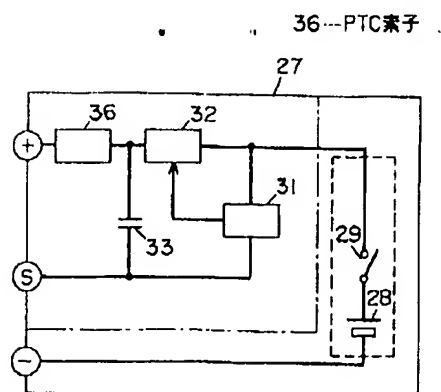


[Drawing 5]

34 --- サーミスタ

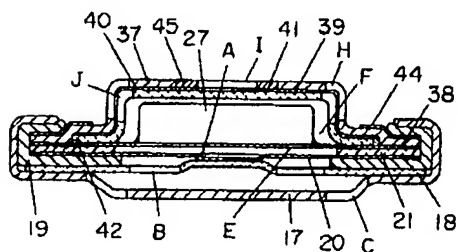


[Drawing 6]

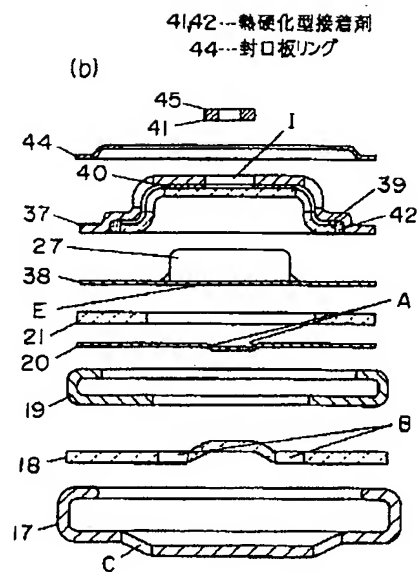
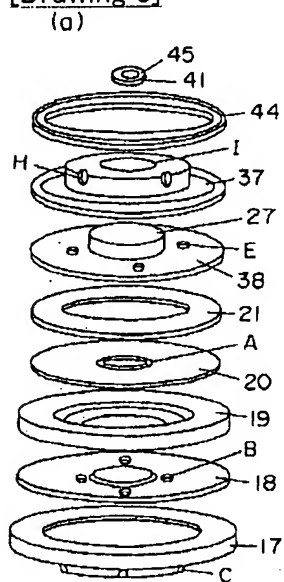


[Drawing 7]

37---安全回路用マイナス極
 38---フレキシブル配線板
 39---二次電池の被制御入出力用プラス極
 41,42---熱硬化型接着剤

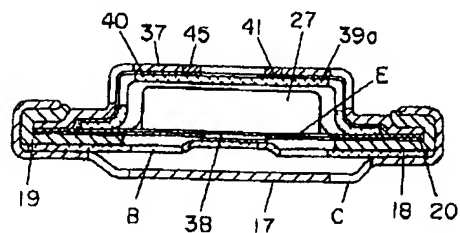


[Drawing 8]



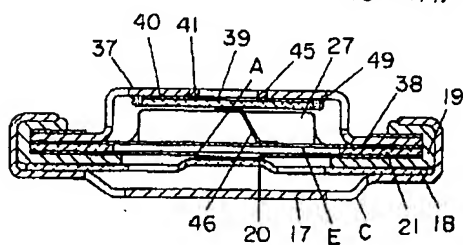
[Drawing 9]

39a...PTC素子で構成した二次電池の被制御入出力プラス極



[Drawing 10]

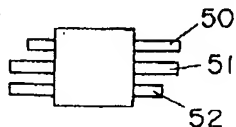
46...ハネ材



[Drawing 11]

50...VDD(GND)リード
51...VIN(VSS)リード
52...Voutリード

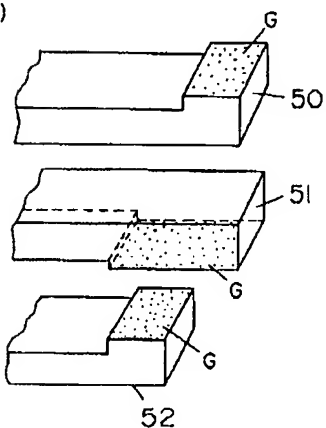
(a)



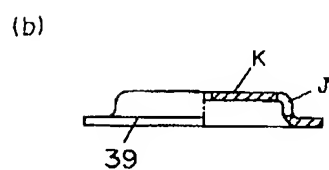
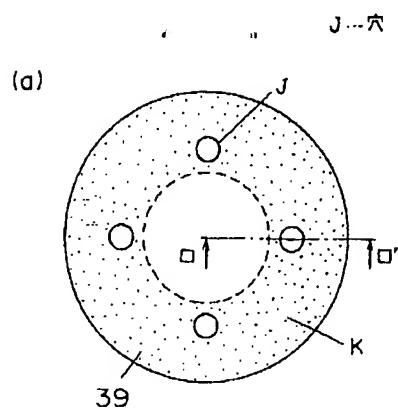
(b)



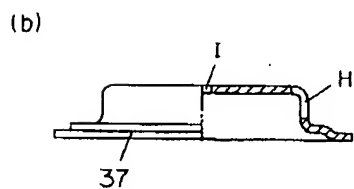
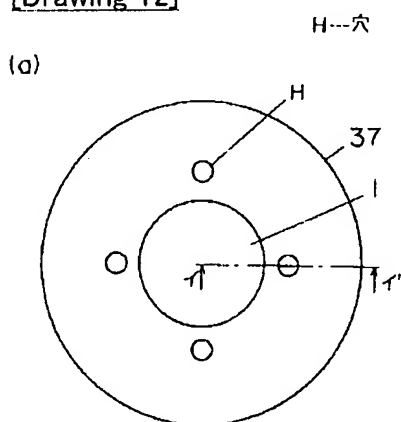
(c)



[Drawing 13]

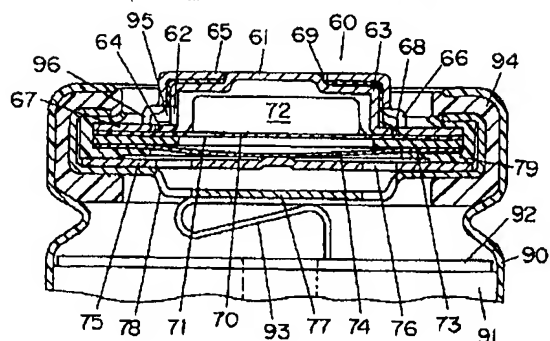


[Drawing 12]

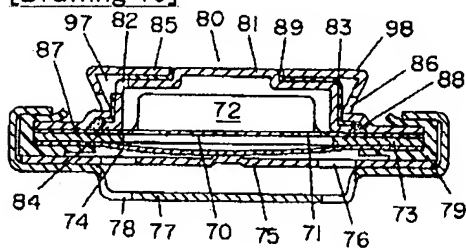


[Drawing 14]

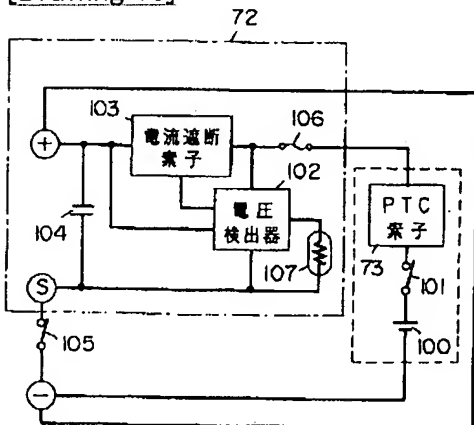
- 61...内側キャップ
 62,66...透孔
 65...外側キャップ
 70...プリント基板
 74...弁体
 95...空洞部
 96...膨出部



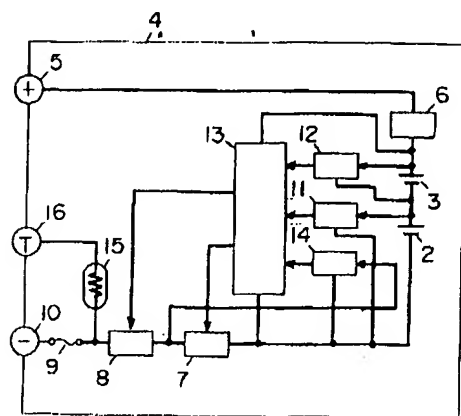
[Drawing 15]



[Drawing 16]



[Drawing 17]



[Translation done.]

Publication number: JP10275612

Publication date: 1998-10-13

Inventor: IWAZONO YOSHINORI; MASUMOTO KANEHITO;
TSURUYA SHINJI

Applicant: MATSUSHITA ELECTRIC IND CO LTD

Classification:

- **international:** *H01M2/34; H01M10/46; H01M2/20; H01M10/42; (IPC1-7): H01M10/46; H01M2/34*

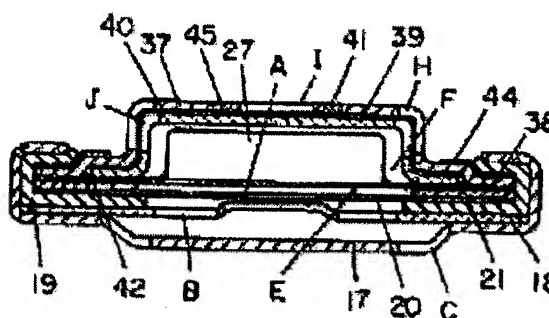
- European:

Application number: JP19970183351 19970709

Priority number(s): JP19970183351 19970709; JP19960178896 19960709;
JP19970015462 19970129

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PROBLEM TO BE SOLVED: To provide a secondary battery capable of assembling an electric circuit constituting a safety gear therein so as to be handled similarly to a conventional cell and quickly releasing gas to prevent the burst of the battery when a gas pressure in the battery is abnormally high. **SOLUTION:** A flexible wiring board 38 with a permeable hole E on which a safety circuit 27 is arranged, a controlled input/output positive pole 39 with a gas permeable hole J and a safety circuit negative pole with a gas permeable hole H put in face contact with the upper face thereof and connected to the safety circuit 27 through wirings, a PTC element 21 put in face contact with the lower face of the flexible wiring board 38 and a valve disc 20 lapped on the lower face thereof and provided with a slit A are integrally formed with an inner gasket 19. A sub-filter 18 welded with the valve disc 20 at the center and provided with a permeable hole B is caulked to the inner gasket 19 on the periphery of a filter 17 with a permeable hole C to form a sealing part.



<http://v3.espacenet.com/textdoc?DB=EPODOC&IDX=JP10275612&F=0>

(51) Int.Cl.⁶

識別記号

F I

H 0 1 M 2/34

H 0 1 M 2/34

A

// H 0 1 M 10/46

10/46

審査請求 未請求 請求項の数23 O L (全 13 頁)

(21) 出願番号 特願平9-183351

(22) 出願日 平成9年(1997)7月9日

(31) 優先権主張番号 特願平8-178896

(32) 優先日 平8(1996)7月9日

(33) 優先権主張国 日本 (J P)

(31) 優先権主張番号 特願平9-15462

(32) 優先日 平9(1997)1月29日

(33) 優先権主張国 日本 (J P)

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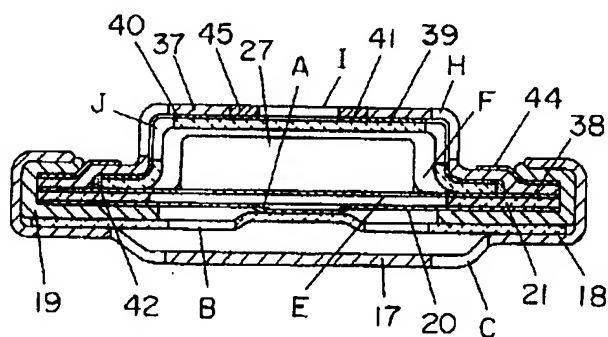
(54) 【発明の名称】 二次電池及び二次電池用組立封口板

(57) 【要約】

【課題】 安全装置を構成する電気回路を組み込み、従来の電池単体と同様に扱うことができ、電池内のガス圧が異常な高圧となるときには、速やかにガスを放出して電池の破裂を未然に防止できる二次電池を提供する。

【解決手段】 透孔Eを有し安全回路27を配置したフレキシブル配線板38と、その上面に面接触しそれぞれ配線を通じて安全回路27に接続される、ガス抜け透孔Jを有する被制御入出力用プラス極39及びガス抜け透孔Hを有する安全回路用マイナス極と、フレキシブル配線板38下面に面接触したPTC素子21と、その下面に重ねられたスリットAが刻まれた弁体20とはインナーガスケット19により一体化され、中央部で弁体20と溶着し透孔Bを有するサブフィルター18とインナーガスケット19とは透孔Cを有するフィルター17の周辺部でかしめられて封口部を構成する。

37---安全回路用マイナス極
38---フレキシブル配線板
39---二次電池の被制御入出力用プラス極
41,42---熱硬化型接着剤



【特許請求の範囲】

【請求項1】 電池要素をキャップにより封口する封口部に、電流遮断素子を有する安全回路を配置した二次電池。

【請求項2】 安全回路を、エポキシ樹脂、ポリ・ブチレン・テレフタレート樹脂のような防水性、防電解液性樹脂により処理した請求項1記載の二次電池。

【請求項3】 安全回路を配置した安全回路基板には開口部または破断機構を設けた請求項1記載の二次電池。

【請求項4】 安全回路に温度ヒューズを配置した請求項1記載の二次電池。

【請求項5】 安全回路にサーミスタを配置した請求項1記載の二次電池。

【請求項6】 二次電池のプラス出力からPCT素子を介して安全回路に接続した請求項1記載の二次電池。

【請求項7】 安全回路のプラス極と外部入出力用プラス極との間にPTC素子を配置した請求項1記載の二次電池。

【請求項8】 封口部のキャップを、安全回路用マイナス極と外部入出力用プラス極との2極構成とした請求項1記載の二次電池。

【請求項9】 安全回路用マイナス極と外部入出力用プラス極とに段差を設けた請求項8記載の二次電池。

【請求項10】 安全回路用マイナス極と外部入出力用プラス極とが、電気絶縁性の接着剤で接着された、または絶縁物を介して組み立てられた請求項8記載の二次電池。

【請求項11】 安全回路用マイナス極に設けたガス抜け透孔の径に対し、外部入出力用プラス極に設けたガス抜け透孔の径を大きくした請求項8記載の二次電池。

【請求項12】 発電要素を収容してその一方の極性の端子を兼ねる電池ケース、および電池ケースの開口部にガスケットを介して装着された組立封口板を具備し、前記組立封口板が、相互に電氣的に絶縁された内側キャップと外側キャップ、および所定の圧力で破断する金属薄板からなり、破断に先立って電氣的導通を断つ電流遮断機能手段を有する弁体を含み、前記キャップの一方は前記弁体をとおして発電要素の他方の極性の電極と電氣的に接続され、両キャップはそれぞれガスを排出するための透孔を有し、かつ両キャップ間には、前記両透孔に連通する空洞部を有することを特徴とする二次電池。

【請求項13】 発電要素を収容してその一方の極性の端子を兼ねる電池ケース、および電池ケースの開口部に電気絶縁性のガスケットを介して装着された組立封口板を具備し、前記組立封口板が、電池に直列に接続された電流遮断素子および電池の電圧を検出して前記電流遮断素子を制御する電圧検出器を含む電気回路を組み込み、かつガスを排出するための透孔または破断機構を有するプリント基板、前記プリント基板上にプリント基板のそれぞれ異なる極性の端子部に接続されて取り付けられた

外側キャップおよび内側キャップ、前記プリント基板より電池内側に配され、所定の圧力で破断する金属薄板からなり、破断に先立って電氣的導通を断つ電流遮断機能手段を有する弁体、および前記プリント基板の一方のキャップに接続されている端子部を前記弁体をとおして発電要素の他方の極性の電極と電氣的に接続する電氣的接続手段を含み、両キャップはそれぞれガスを排出するための透孔を有し、かつ両キャップ間には、前記両透孔に連通する空洞部を有し、前記電気回路は、電池が機器にセットされた際他方のキャップを介して前記一方の極性の端子に接続されることを特徴とする二次電池。

【請求項14】 電気回路における電流遮断素子が電池への過電流の入力、電池からの過電流の出力、または過電流の入出力を遮断するように制御される請求項13記載の二次電池。

【請求項15】 両キャップはそれぞれガスを排出するための透孔を側面に有し、かつ空洞部が外側キャップの側面に設けた膨出部の内側に形成されている請求項12または13記載の二次電池。

【請求項16】 膨出部が外側キャップの上部周縁部に設けられている請求項15記載の二次電池。

【請求項17】 外側キャップの透孔が、内側キャップの透孔より下位に設けられている請求項14または15記載の二次電池。

【請求項18】 電氣的接続手段が、PTC素子を含む請求項13記載の二次電池。

【請求項19】 電氣的接続手段が、中央部において弁体に溶着され、周縁部においては電氣的に絶縁されているサブフィルターを含み、前記サブフィルターはガスをとおす透孔を有し、かつ前記サブフィルターと前記弁体との溶着部は、弁体にかかるガス圧が所定値を越えると外れてサブフィルターと弁体との電氣的接続を断つ電流遮断機能手段として働く請求項13記載の二次電池。

【請求項20】 プリント基板に代えて電池に直列に接続された電流遮断素子および電池の電圧を検出して前記電流遮断素子を制御する電圧検出器を含む電気回路を一体化して前記プリント基板の端子部に相当する端子を設けたパッケージを配したことを特徴とする請求項13記載の二次電池。

【請求項21】 相互に電氣的に絶縁された内側キャップと外側キャップ、所定の圧力で破断する金属薄板からなり、破断に先立って電氣的導通を断つ電流遮断機能手段を有する弁体、および前記キャップの一方を前記弁体をとおして発電要素の一方の極性の電極と電氣的に接続する手段を具備し、両キャップはそれぞれガスを排出するための透孔を有し、かつ両キャップ間には、前記両透孔に連通する空洞部を有することを特徴とする二次電池用組立封口板。

【請求項22】 電池に直列に接続される電流遮断素子および電池の電圧を検出して前記電流遮断素子を制御す

る電圧検出器を含む電気回路を組み込み、かつガスを排出するための透孔または破断機構を有するプリント基板、前記プリント基板上にプリント基板のそれぞれ異なる極性の端子部に接続されて取り付けられた外側キャップおよび内側キャップ、前記プリント基板より電池内側に配され、所定の圧力で破断する金属薄板からなり、破断に先立って電気的導通を断つ電流遮断機能手段を有する弁体、および前記プリント基板の一方のキャップに接続されている端子部を前記弁体をとおりて発電要素のいずれかの極性の電極と電気的に接続する電気的接続手段を含み、両キャップはそれぞれガスを排出するための透孔を有し、かつ両キャップ間には、前記両透孔に連通する空洞部を有することを特徴とする二次電池用組立封口板。

【請求項23】 プリント基板に代えて電池に直列に接続された電流遮断素子および電池の電圧を検出して前記電流遮断素子を制御する電圧検出器を含む電気回路を一体化して前記プリント基板の端子部に相当する端子を設けたパッケージを配したことを特徴とする請求項22記載の二次電池用組立封口板。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、リチウムイオン二次電池等の密封形の二次電池に安全装置を内蔵した電池に関するもので、特に安全装置の電気回路を小型化し、電池の封口部内に実装配置したもの及び安全装置を組み込んだ二次電池用の組立封口板に関するものである。

【0002】

【従来の技術】密閉形二次電池、中でもリチウムイオン二次電池は、高エネルギー密度を有するところからビデオカメラ、携帯電話、パソコンなどの小型ポータブル機器の駆動用電源としての需要が急速に拡大している。このリチウムイオン二次電池は、過充電、過放電および過電流から保護するための安全回路としての電気回路を含む安全装置を必要とする。そこで、通常は、電池に安全回路としての電気回路を組み合わせたバック形電池として電池使用機器に組み込まれる。

【0003】リチウムイオン二次電池を用いたバック形電池は、模式図を示す図1のような構成で、図1において、1は円筒型のリチウムイオン二次電池2、3を被供給装置に装着できる形状に実装する筐体、4はリチウムイオン二次電池2、3と筐体1の端子間に挿入した安全回路である。

【0004】従来における安全回路4の構成を図17にブロック図として示し、充電器からのプラス電圧が、プラス端子5、PTC素子6、リチウムイオン二次電池3および2、FET7および8、温度ヒューズ9、端子10を経由して充電器のマイナス側に流れることにより、リチウムイオン二次電池2、3の充電が行われる。

【0005】また、リチウムイオン二次電池2、3の放

電は、PTC素子6、プラス端子5、機器のプラスおよびマイナス、マイナス端子10、温度ヒューズ9、FET8および7を経由して行われる。電池電圧を監視する電圧検出器11、12は、制御回路13に接続され、電池電圧が規定値より高くなるとFET8をオフにして過充電防止の機能をし、規定値より低くなるとFET7をオフにして過放電防止の機能をし、電流を遮断する。FET7のソースドレイン間の電圧を検出する電圧検出器14は、制御回路13に接続され、プラス端子5からマイナス端子10間に外部短絡等により過大電流が発生した場合には、FET7および8をオフにして電流を遮断する。サーミスタ15は、端子16を介して充電器、または、使用機器の側から電池の温度をモニターするものである。

【0006】以上のように、従来のバック形電池では、電池単体の過充電を防止する機能、過放電を防止する機能、過大電流時の遮断機能、電池温度モニター機能等が、安全回路4としてプリント基板に実装配置され、筐体1の内部に構成されている。

【0007】

【発明が解決しようとする課題】上記のような従来のバック形電池にあつては、以下に説明するような問題点があった。

【0008】1)バック形電池を被供給装置に装着し易いように、筐体1の形状およびデザインが形成されているために、筐体1は被供給装置に対応した専用のものとなるケースが多い。

【0009】2)筐体1が被供給装置に装着できる形状およびデザインになっているために、充電器を筐体1に合わせる必要があり、被供給装置に対応する専用の充電器が必要となる。

【0010】3)安全回路や被供給装置に装着するための形状およびデザインにした端子構造を設けることが必要となり、これらに起因する体積が収納されるリチウムイオン二次電池2、3の体積に比べ極めて大きくなる。

【0011】4)一般消費者がリチウムイオン等の二次電池単体入手し難い。このように従来のバック形電池は汎用性に乏しいものであった。

【0012】本発明は、特に電池内部に安全装置を構成する電気回路を組み込んでおり、それ自体を従来の電池単体と同様に扱うことができる安全装置付きの二次電池を提供することを目的とする。

【0013】また本発明は、電池内が異常な高圧になって弁体が破断した際、ガスを容易に外部へ排出することができる封口板を備えた二次電池を提供することを目的とする。

【0014】

【課題を解決するための手段】上記の問題点を解決するために、本発明の二次電池は、電流遮断素子を有する安全回路を封口部に配置することとしている。そして、二

次電池の上部にある封口部のキャップと電流遮断弁との間のように、通常時は直接電解液に触れない部分に、超小型化した安全回路を配置することにより、安全回路を内蔵した二次電池自体を従来の電池単体と同様に扱うことができ、被供給装置の電池収納室へ二次電池を容易に収納することができる。

【0015】また本発明は、発電要素を収容した一方の極性の端子を兼ねる電池ケースの開口部にガスケットを介して装着される組立封口板を改良したものである。すなわち、本発明による組立封口板は、相互に電氣的に絶縁された内側キャップと外側キャップ、および所定の圧力で破断する金属薄板からなり、破断に先立って電氣的導通を断つ電流遮断機能手段を有する弁体を含み、前記キャップの一方は前記弁体をとおして発電要素の他方の極性の電極と電氣的に接続され、両キャップはそれぞれガスを排出するための透孔を有し、かつ両キャップ間には、前記両透孔に連通する空洞部を有することを特徴とする。

【0016】この空洞部の存在により、一時に多量に発生して弁体を破断したガスが内側キャップの透孔から外側キャップの透孔へ容易に移行し、外部に放出される。これによって電池が破裂する危惧をなくすることができる。

【0017】

【発明の実施の形態】本発明は、単電池の上部、すなわちプラス極側であって、キャップ、PTC素子、防爆弁、電流遮断弁およびこれらを固定するガスケット等で形成される封口部の、例えばキャップと電流遮断弁との間のように、通常時は直接電解液に触れない部分に、電圧検出器とFET等の電流遮断素子を基本構成とし、制御回路、コンデンサ、抵抗、ヒューズ等の電子部品で構成された安全回路を配置したものであり、これにより、安全回路を内蔵した二次電池を従来の電池単体と同様に扱って、被供給装置の電池収納室へ簡単に収納できる。

【0018】また、安全回路は、例えばエポキシ樹脂、ポリ・ブチレン・テレフタレート樹脂等で防水性、防電解液性の処理、すなわちコーティング処理、封止処理したものであり、外部から侵入した水、および電池自身の電解液から安全回路部を保護するものである。

【0019】また安全回路基板に開口部を設けたり、または安全回路基板の一部が電池の内圧上昇によって破断するようにしたものであり、安全回路部に侵入した電解液、もしくはガス化した電解液は、安全回路基板の開口部、もしくは空隙部、もしくは破断機構を通じて、キャップ部のガス抜け透孔から電池外へ放出することができる。

【0020】また、安全回路に温度ヒューズを配置したものであり、FET等の電流遮断素子または電池自身の発熱によって温度ヒューズを溶断することにより、電池

のプラス極と外部へのプラス出力端子との間の電氣的な接続を遮断することができる。

【0021】また、安全回路にサーミスタを配置したものであり、充電温度範囲を規定することにより、電池の安全性を確保することができる。

【0022】また、PTC素子を介して安全回路に接続したものであり、FET等の電流遮断素子の発熱によってもPTC素子をトリップさせることができる。

【0023】また、リング状PTC素子(図2におけるPTC21に相当)に代えて、安全回路のプラス極と外部入出力プラス極との間にPTC素子を配置したものであり、電池出力の短絡等による過大電流時や、電池の温度、または安全回路の温度によってもPTC素子をトリップさせることができる。

【0024】また、封口部のキャップを、安全回路用マイナス極と外部入出力用プラス極との2極構成としたものであり、電池の外周面または底面のマイナス極と安全回路用マイナス極が、被供給装置または充電器側で接続されるまで、安全回路の消費電流を発生しないことから、電池の過放電保護機能を不要とすることができる。安全回路は、半導体の高集積化技術、部品の小型化技術およびこれらを実装する高密度実装技術と合わせ、電池の上部にある封口部におけるキャップと電流遮断弁との間のように、通常時は直接電解液に触れない部分に、超小型化して配置することができる。

【0025】また、キャップにおける安全回路用マイナス極と外部入出力用プラス極とに段差を設けたものであり、電池の取り扱い時に起こる外部短絡を発生し難くすることができる。

【0026】また、キャップにおける安全回路用マイナス極と外部入出力用プラス極とを、電氣的に絶縁性の接着剤、例えばエポキシ系等の熱硬化型接着剤で接着したものまたは電氣的な絶縁物を介して組み立てたものであり、キャップ全体の強度確保、キャップの安全回路用マイナス極と外部入出力用プラス極との間の固定および絶縁を良好にすることができる。

【0027】また、キャップにおける安全回路用マイナス極のガス抜け透孔の径に対し、外部入出力用プラス極側のガス抜け透孔の径を大きくしたものであり、キャップ部のガス抜け透孔の周辺における電氣的なショートを発生し難くすることができる。

【0028】本発明による好ましい構成の二次電池は、一方の極性の端子を兼ねる電池ケース、および電池ケースの開口部にガスケットを介して装着された組立封口板を具備し、前記組立封口板が、電池に直列に接続された電流遮断素子および電池の電圧を検出して前記電流遮断素子を制御する電圧検出器を含む電気回路を組み込んだプリント基板を含んでいる。このプリント基板は、ガスを排出するための透孔を有し、しかもプリント基板上には、プリント基板のそれぞれ異なる極性の端子部に接続

された外側キャップおよび内側キャップが取り付けられている。

【0029】組立封口板は、さらに、プリント基板より電池内側に配され、所定の圧力で破断する金属薄板からなる弁体、および前記プリント基板の一方のキャップに接続されている端子部を前記弁体をとおして発電要素の他方の極性の電極と電気的に接続する電氣的接続手段を含んでいる。そして、外側キャップおよび内側キャップは、それぞれガスを排出するための透孔を有し、かつ両キャップ間には、前記両透孔に連通する空洞部を有し、また前記弁体は破断に先立って電氣的導通を断つように構成されている。また、前記電気回路は、電池が機器にセットされた際他方のキャップを介して前記一方の極性の端子に接続される。

【0030】この構成の第1の特徴は、外側キャップと内側キャップとの間に両キャップの透孔に連通する空洞部を有することである。この空洞部は、前記のように、電池内が異常な高圧となり、弁体を破断したガスが内側キャップの透孔から外側キャップの透孔へ容易に移行させる働きをする。両キャップに設ける透孔がそれぞれ対応する位置にあれば、前記の空洞部を特別に設ける必要はない。そのような構成にするためには、キャップの組み立て時に位置合わせが必要となり、作業上煩雑となる。また、両キャップの透孔の位置が一致していると、ヘヤーピンのような線状の金属部材が両者の透孔に入り込んで、両キャップを電氣的に接続し、電池を短絡させるという不都合が生じるおそれがある。本発明によれば、封口板組み立て時に透孔を一致させるための特別な管理も不要であり、しかも線状金属部材による短絡の危険を少なくすることができる。

【0031】また、外側キャップおよび内側キャップは、それぞれガスを排出するための前記透孔を側面に有し、かつ前記空洞部が外側キャップの側面に設けた膨出部の内側に形成されていることが好ましい。この構成によって、内側キャップ内のスペースを最大限に活用することができる。

【0032】外側キャップは、その上面周縁部に膨出部を設けるのが好ましい。この膨出部は、電池を機器にセットする際、機器の端子部にスナップホック式に装着することができる。

【0033】また、膨出部を外側キャップの上面周縁部に設けた構成においては、外側キャップのガスを排出するための透孔は、内側キャップの透孔より下位に設けるのが好ましい。この構成によると、例えば、ヘヤーピンのような線状の金属部材が外側キャップの透孔から内側キャップとの間の空隙部に入り込んで両キャップを電氣的に接続し、電池を短絡させるようなことはなくなる。

【0034】前記プリント基板に組み込まれた電気回路は、電池への過電流の入力、電池からの過電流の出力、または過電流の入出力を遮断する機能を有することが好

ましい。例えば、前記電圧検出器で前記電流遮断素子の入力側と出力側との間の電圧を検出し、検出される電圧が所定の電圧を越えたとき電流遮断素子をオフするように構成する。

【0035】また、前記電気回路は、温度検出器を備え、検出される温度が所定の温度範囲を外れたとき前記電流遮断素子をオフするように構成することが好ましい。

【0036】さらに、前記電気回路は、電池と直列に接続された温度ヒューズを含むことが好ましい。

【0037】前記電氣的接続手段は、さらにPTC素子を含むことが好ましい。このPTC素子は、この電氣的接続手段に組み入れる代わりに、前記プリント基板に組み込まれた電気回路に含めることもできる。

【0038】また、前記電氣的接続手段は、さらに好ましくは、中央部において前記弁体に溶着され、周縁部においては電氣的に絶縁されているサブフィルターを含み、前記サブフィルターはガスをとおす透孔を有し、かつ前記サブフィルターと弁体との溶着部は、ガス圧が所定値を越えると外れる電流遮断機能手段として働くように構成されている。

【0039】また前記プリント基板に代えて電池に直列に接続された電流遮断素子および電池の電圧を検出して前記電流遮断素子を制御する電圧検出器を含む電気回路部をICの様にモールドして一体化して前記プリント基板の端子部に相当する端子を設け、この端子間に空隙部を設けたパッケージを配することができる。

【0040】本発明によれば、組立封口板の内側キャップ内に、電池の安全回路を組み入れるスペースを確保できるから、従来のように、安全回路を電池外に組み合わせた特定の電池使用機器にのみ適合する電池パックとする必要がなく、安全回路を内蔵した独立の電池を提供することができる。

【0041】

【実施例】以下、本発明の実施例について、図2から図16を参照して説明する。

【0042】（実施例1）図2は、円筒型リチウムイオン二次電池の封口部の断面図、図3(a)は同封口部の分解斜視図、図3(b)は同封口部の分解断面図を示している。この封口部は、電池発熱時の電流低減機能手段であるPTC素子、電池内圧上昇時の電流遮断機能手段である電流遮断弁、電池内圧が更に上昇した時の防爆機能手段である防爆弁を有し、フィルター17、サブフィルター18、インナーガスカート19、弁体20、PTC素子21、キャップ22、封口板リング23、ガスカート24で構成されている。通常時は、正極からの電流が、リード板25を介して透孔Cを有するフィルター17に接続され、ついでこれと面接触し、透孔Bを有するサブフィルター18に通じるようになっている。更に、サブフィルター18と弁体20とは溶着によって中央部

が接合されているため、正極の電流は、弁体20を通り、これと面接触したリング状のPTC素子21を通して透孔Dを有するキャップ22に導かれる。

【0043】キャップ22とPTC素子21および弁体20は、リング状のインナーガasket19により一体化されており、このインナーガasket19は、ポリカーボネイト等の絶縁体を成形したものである。サブフィルター18と弁体20との電気的な接続は、溶着部のみに限定されている。フィルター17の周縁部は、サブフィルター18およびインナーガasket19の周縁部をカシメる構造となっており、カシメが終了した後は、封口部を構成するアッセンブリーとして一体物となっている。ガasket24は、ポリカーボネイト等の絶縁体をリング状に成形したもので、前記の封口部のアッセンブリーを電池ケース26に組み込んでカシメ封口した場合、電池ケース26とフィルター17との間の絶縁を行っている。

【0044】弁体20には、防爆機能手段である防爆弁としてスリットAが刻まれており、ガス化した電解液が発生した場合は、フィルター17の透孔Cおよびサブフィルター18に設けられた透孔Bを通過して、弁体20をキャップ22の側に押し上げる構造となっている。

【0045】つぎに、PTC素子21による電流低減機能手段について説明する。PTC素子21は、規定温度になると抵抗値が急上昇する素子であり、過充電、または大きな放電電流、例えば1時間放電に相当する電流値以上の電流によって電池の温度が上昇し、規定温度に達すると抵抗値が上昇して電流を低減させることにより、電池が熱的に不安全な状態になることを防止するものである。

【0046】また、サブフィルター18と弁体20とを溶着することによる電池内圧上昇時の電流遮断機能手段について説明する。発熱によってガス化した電解液は、フィルター17の透孔Cおよびサブフィルター18に設けられた透孔Bを介して、弁体20をキャップ22の側に押し上げる。この際、ガスの圧力が、サブフィルター18と弁体20との溶着力を上回った時点で溶着が外れることにより、電気的な接続が遮断され、電流遮断弁としての作用を行うものである。

【0047】更に、弁体20による防爆機能手段について説明する。サブフィルター18と弁体20とによる電流遮断機能手段が作動した後、発熱によってガス化した電解液は、弁体20を更にキャップ22の側に押し上げる。一方、弁体20は、インナーガasket19、フィルター17、ガasket24、電池ケース26によって周囲が固定されているため、ガスの圧力により弁体20に設けられたスリットAが破断され、その時点で、ガス化した電解液がキャップ22側に抜ける。このことにより、ガス化した電解液は、キャップ22の透孔Dより放出され、その圧力が減圧されて電池自体の爆発を防止す

る。

【0048】図4は、本発明のリチウムイオン二次電池が備える安全回路のブロック図である。図4において、+は安全回路27によって制御される二次電池28の外部への入出力用プラス極、Sは安全回路27のマイナス極で、被供給装置または充電器の側で二次電池28の外周面または底面に形成したマイナス極と接続する。-は二次電池28の外周面または底面に形成したマイナス極である。

【0049】二次電池28のプラス出力は、図2で説明したサブフィルター18と弁体20とによって構成される電流遮断機能手段29、PTC素子30（図2におけるPTC素子21に相当）を介して安全回路27へ接続される。

【0050】S端子が被供給装置または充電器の側で二次電池28のマイナス極と接続された状態にある場合、PTC素子30の出力側とS端子との間の電圧が規定値内にあると、封口部に内蔵された電圧検出器31は、FET等の電流遮断素子32をオンにし、充電器からの充電を可能とする。一方、PTC素子30の出力側とS端子との間の電圧が規定値より高くなると、電圧検出器31は、FET等の電流遮断素子32をオフにし、二次電池28を過充電から保護する。

【0051】安全回路27は以上の作用を行うが、電流遮断素子32にFETを使用する場合、FETがオフの状態であっても、そのボディダイオード効果により、+極を通じて二次電池28の放電が可能である。なお、コンデンサ33は、+極と-極との間の静電気対策、ノイズによる誤動作防止を行うものである。

【0052】また、図5は、図4に示す安全回路27の変形例を示すもので、サーミスタ34を追加し、サーミスタ34の温度による抵抗値変化をモニターする機能が追加された電圧検出器35により、二次電池28の温度が規定範囲（0℃～60℃以内等）外になると、FET等の電流遮断素子32をオフにする作用を追加したものである。

【0053】更に、図6は、図4に示す安全回路27の他の変形例を示すもので、従来のリング状PTC素子（図2におけるPTC素子21に相当）を廃止し、安全回路のプラス端子と外部入出力用プラス極との間にPTC素子36を挿入したものである。

【0054】なお、以上の説明では、安全回路27のマイナス極Sに与えるマイナス電圧を、電池ケースのマイナスから電池が装着される被供給装置または充電器の結線を介して得ると説明したが、安全回路27用のマイナス電圧を電池ケースと直接接続することも実施可能である。但し、この場合は、電池を使用しない時の安全回路27の消費電流による自己放電損失が問題となるので、長期保存に対応する施策が必要となる。

【0055】（実施例2）図4に示す安全回路27を二

次電池28の封口部に組み込んだ場合について図7および図8を参照して説明する。図7は封口部の断面図、図8(a)は同封口部の分解斜視図、図8(b)は同封口部の分解断面図を示し、図2の場合とは、PTC素子21から安全回路用マイナス極37に至る部分が異なる構造となっている。

【0056】図7および図8において、PTC素子21の電極は、ポリイミド材で構成されたフレキシブル配線板38と面接触し、スルーホールや配線を通じて安全回路27に接続されている。なお、Eは、フレキシブル配線板38に設けられた防爆構造のための透孔であり、上述の安全回路基板の開口部に相当し、また上述の安全回路基板の破断機構、すなわちプリント基板に圧力により破断しやすい部分を設けても良い。一方、安全回路用マイナス極37は、フレキシブル配線板38に面接触し、配線を通じて安全回路27に接続されている。安全回路27によって制御される二次電池28の入出力端+は、フレキシブル配線板38を通じ、面接触で、二次電池の被制御入出力用プラス極39となる。なお、Fは安全回路27の防水性、耐電解液性のコーティング、41、42はエポキシ系等の熱硬化型接着剤、40、45は安全回路用マイナス極37と二次電池の被制御入出力用プラス極39との間を絶縁するABS樹脂等の絶縁物、44は封口板リングである。

【0057】(実施例3)図6に示すように、安全回路のプラス極と外部入出力用プラス極との間にPTC素子36を配置した場合は、図9に示すように二次電池の被制御入出力用プラス極39a自体をPTC素子で構成することができる。その他の部分の構成は図7および図8と同様である。

【0058】(実施例4)図7における二次電池の被制御入出力用プラス極39とフレキシブル配線板38との接続は、図10に示すように、二次電池の被制御入出力用プラス極39が、リン青銅等のバネ材46により、フレキシブル配線板38上の部品へ接続されるようにしても良い。この場合は、電池キャップの構成を簡略化することが可能になると共に、フレキシブル配線板38の下側は、対面するPTC素子21を介して弁体20に、フレキシブル配線板38の上側は、対面する安全回路用マイナス極37に、それぞれ面接触させる構成になるので、封口部全体を容易に構成できる。なお、41、49はエポキシ系等の熱硬化型接着剤である。

【0059】以上に説明した安全回路27は、図11に示すようにICパッケージ仕様とすることができる。図11において、50はVDD(GND)リード、51はVIN(VSS)リード、52はVOUTリードで、それぞれのリード50、51、52は、図7においてプリント基板38の代わりに配置することができ、安全回路用マイナス極37、PTC素子21、二次電池の被制御入出力用プラス極39に接触する部分Gを除き、PBT

(ポリ・ブチレン・テレフタレート)等の耐電解液材料で絶縁コーティング処理を行ったもので、プリント基板が不要となり、封口部を組み立てる時に、アッセンブリが容易となる。またリード50、51、52の空間は上述の空隙部に相当し、放出されるガス化した電解液の通路となる。

【0060】また、図7における安全回路用マイナス極37は、図12に示すように防爆構造のための複数のガス抜け透孔Hと、二次電池の被制御入出力用プラス極39に安全回路用マイナス極37の表面から機械的に接触させるための透孔Iを有する必要がある、この場合の二次電池の被制御入出力用プラス極39には、図13に示すように安全回路用マイナス極37の複数のガス抜け透孔Hより大きい複数のガス抜け透孔Jと、安全回路用マイナス極37を介して二次電池の被制御入出力用プラス極39に安全回路用マイナス極37の表面から機械的に接触させるための透孔Iにかからない範囲Kに、エポキシ系等の熱硬化型接着剤が塗布されている。安全回路用マイナス極37と二次電池の被制御入出力用プラス極39とは、あらかじめそれぞれ穴加工されたニッケル材等の金属材料に、エポキシ系等の熱硬化型接着剤を塗布したうえで、一体に形成することも可能である。

【0061】(実施例5)図14は本実施例の組立封口板を備えたリチウムイオン二次電池の要部の縦断面図である。ここに示す組立封口板60は、内側キャップ61、外側キャップ65、及び素子72を取り付けたプリント基板70を備えている。

【0062】組立封口板は、さらに、プリント基板70の下面に配置されたリング状のPCT素子73、金属薄板からなる弁体74、中央部に弁体74の中央部を溶着し、ガスを通すための透孔76を有するサブフィルター75、ガスを通すための透孔78を有するフィルター77、及びインナーガasket79を備えている。そして、インナーガasket79は、外キャップ65の周縁部から弁体74の周縁部にわたる部分を被覆することにより、弁体74とサブフィルター75の周縁部における電気的接触を阻止している。また、フィルター77は、その周縁部でサブフィルター75とインナーガasket79の周縁部を挟み込むことにより、全体を一体の組立封口板として組み立てている。フィルター77の上面周縁部は、インナーガasket79により、外キャップ65、プリント基板70、PTC素子73、および弁体74の周縁部とは電気的接触を阻止されている。

【0063】次に、上記プリント基板70について詳しく説明する。プリント基板70は、可撓性の絶縁板に配線を施したもので、後述する安全回路を構成する電気回路をパッケージした素子72を中央に固定するとともに、素子72を覆うように内側キャップ61及び外側キャップ65を電気絶縁性の接着剤68、たとえばエポキシ樹脂により固定している。プリント基板70は、ガス

を通すための透孔71を複数有している。

【0064】内側キャップ61は、ガスを通すための透孔62を4個有し、外表面には、外側キャップ65と電気的に絶縁するための絶縁性被膜63を有している。また、外側キャップ65は、内側キャップ61との間にガスを通す空洞部95を形成するために、外側に膨出させた膨出部96を設け、さらにこの膨出部96にガスを通す透孔66を4個設けている。さらに、内側キャップ61と外側キャップ65とをそれらの上部において絶縁する接着剤69が両者間に介在させてある。素子72を接続したプリント基板70のマイナス端子には内側キャップ61の鍔部64が、またプラス端子には外側キャップ65の鍔部67及びPTC素子73がそれぞれ接続されるように、プリント基板には配線が施されている。

【0065】上記のように構成された組立封口板60は、電池ケース90の開口部に装着される。電池ケース90内には正極板と負極板とをセパレータを介して渦巻き状に捲回された極板群91が挿入されている。極板群の一方の電極、例えば正極のリード板93を組立封口板60のフィルター77に溶接した後、組立封口板60の周縁部にガスケット94を装着し、このガスケット部分にケース90の上端部をかしめることにより、電池ケース90は液密かつ気密に密閉される。なお、92は、絶縁板を示している。極板群91の負極リード板(図示しない)は電池ケースの底面に溶接されている。従って、電池ケース90は電池の負極端子を兼ねている。

【0066】上記のように組立封口板60が電池ケース90に装着されると、外側キャップ65は、プリント基板70、これに接触しているPTC素子73、素子73に接触している弁体74、この弁体74と中央部において接合されているサブフィルター75、およびフィルター77を介して極板群91の正極に接続され、正極端子として働く。

【0067】次に、図16に示す安全装置について説明する。図16において、100は組立封口板60が装着された二次電池を示している。101は電池の正極リードにつながっているサブフィルター75と弁体74との接合部で構成される電流遮断機能手段として機能するスイッチを示している。このスイッチ101には前記のPTC素子73が直列に接続されている。電気回路をパッケージした素子72内には、PTC素子73に直列に接続された温度ヒューズ106および電流遮断素子103、電圧を検出して電流遮断素子103を制御する電圧検出器102、サーミスタ107、ならびにコンデンサ104が組み込まれている。

【0068】そして、素子72のプラス端子は外側キャップ65に接続されている。一方、マイナス端子Sは、内側キャップ61に接続され、これはスイッチ105を介して電池の負極端子に接続されている。したがって、この電池を電池使用機器にセットすると、電池の負極端

子である電池ケースに接続された機器側の負極端子が、内側キャップ61と電気的に導通するのである。すなわち、スイッチ105は、電池を機器にセットすることによりオンされるのである。

【0069】上記のように、組立封口板60が装着された電池を機器にセットし、スイッチ105がオンされると、PTC素子73の出力側とS端子との間には所定の電圧が印加され、電圧検出器102は電流遮断素子103をオンにし、充電器からの充電電流の受け入れを可能とする。また、PTC素子73の出力側とS端子との間の電圧に現れる電池100の電圧が規定値より高くなると、電圧検出器102は電流遮断素子103をオフにし、電池100を過充電電流から保護する。

【0070】素子72に組み込まれた安全回路について、さらに詳しく説明する。電圧検出器102は、電池100の電圧および電流遮断素子103の電圧を検出して電流遮断素子を制御する。電圧検出器102で検出される電池100の電圧が所定の上限の設定電圧より高いときは過充電であり、また電圧検出器102で検出される電池100の電圧が所定の下限の設定電圧より低いときは過放電である。電圧検出器102は、検出される電池電圧が所定の上限電圧を越えたときまたは所定の下限電圧を下回ったとき、電流遮断素子103をオフにし、電流を遮断する。また、電圧検出器102は、例えば電界効果トランジスタ(FET)からなる電流遮断素子103の入力側と出力側との間の電圧を検出し、所定の設定電圧より高くなったとき、例えば、短絡などによって過大電流が流れたことを検出して電流遮断素子103をオフにする。さらに、電圧検出器102は、サーミスタ107の電圧を検出し、電池100および電流遮断素子103の温度が規定範囲、例えば電池温度が0℃～60℃の範囲を外れたとき、電流遮断素子103をオフにする。温度ヒューズ106は、電池100や電流遮断素子103の異常発熱によって断たれる安全装置として働く。

【0071】素子72に組み込まれた安全回路は、以上のような働きをする。電流遮断素子103としてFETを使用すると、これがオフの状態においても、そのボデーダイオード効果により、プラス極を通じて電池100の放電は可能である。なお、コンデンサ104は、プラス極とマイナス極との間の静電気対策のために設けられたもので、ノイズによる誤動作を防止する。PTC素子73は、規定温度になると、抵抗値が急上昇する。過充電電流、または大きな放電電流、例えば1時間率放電に相当する電流値以上の電流が流れることによって電池の温度が上昇し、PTC素子73が規定温度に達すると、その抵抗値が急上昇して電流が低減される。これによって、電池が熱的に不安全的な状態になることが防止される。このPTC素子73は、素子72内に組み込むこともできる。

【0072】次に、電池内圧力が上昇した場合の組立封口板の働きについて説明する。上記のような安全回路およびPTC素子の働きにもかかわらず電池内が高温となり、有機溶媒を主とする電解液がガス化すると、ガスはフィルター77の透孔78およびサブフィルター75の透孔76を通して弁体74をプリント基板側へ押し上げる。ガス圧力が、サブフィルター75と弁体74との溶着力を上回った時点で溶着部が外れ、サブフィルター75と弁体74との電気的な接続が遮断される。これによって電池とその充電回路および／または放電回路との間の電気的接続は一切断たれる。このように、サブフィルター75と弁体74とは、電流遮断機能を有するスイッチ、すなわち電流遮断機能手段として働く。

【0073】次に、ガス圧力がさらに大きくなると、弁体74はさらにプリント基板側へ押圧される。そして、ガス圧がある値を越えると、弁体74はその表面の一部に設けられた刻み目（図示しない）から破断する。このため、ガスはその破断部からプリント基板の透孔71を通り、さらに内側キャップ61の透孔62、内側キャップ61と外側キャップ65との間の空洞部95、および外側キャップ65の透孔66を経て外部へ放出される。

【0074】この際、内側キャップ61と外側キャップ65との間には、空洞部95が設けてあるので、両キャップの透孔62と66の位置が一致していなくとも、透孔62を通過したガスは空洞部95を通過して容易に透孔66に達し、そこから外部に放出される。空洞部95がないと、両キャップの透孔62と66の位置が一致していないところでは、一時に多量に発生したガスが両キャップ間の狭い間隙を通り抜けることができず、電池内が過圧となり、破裂する危険が伴う。

【0075】こうして電池が高温になるなどにより電解液がガス化し、電池内圧力が異常に上昇したときには、サブフィルター75と弁体74との電流遮断機能手段により電流を遮断し、さらに圧力が上昇すると、防爆機能手段として弁体74が破断し、キャップ61および65の透孔より外部に放出される。従って、電池自体が破裂する危険はない。

【0076】（実施例6）図15は本実施例の組立封口板の要部の縦断面図である。この組立封口板80は、内側キャップ81および外側キャップ85の構造が変わっている他は実施例5の組立封口板60と本質的な違いはない。内側キャップ81は、その鍔部84がプリント基板70のマイナス端子に接触するように、また外側キャップ85は、その鍔部87がプリント基板70のプラス端子に接触するようにそれぞれ接着剤88によりプリント基板70に接着されている。内側キャップ81は、ガスを通すための透孔82を、側面上方に有する。

【0077】一方、外側キャップ85は、ガスを通すための透孔86を、側面下方に有する。そして、外側キャップ85は、上部周縁部を外側に膨出させることによ

り、内側キャップ81との間に空洞部97を設けている。この膨出部98は、電池を機器にセットする際、機器の端子部にスナップホック式に装着できる。内側キャップの外表面に絶縁性皮膜83を設けたこと、および両キャップ間に絶縁材89を介在させたことは実施例5と全く同様である。

【0078】この構成においても、弁体74を破断して内側キャップ81の透孔82に入ったガスは、空洞部97から容易に外側キャップ85の透孔86を抜けて外部へ放出される。また、外側キャップ85のガスを排出するための透孔86は、内側キャップ81の透孔82より下位にあるので、ヘヤーピンのような線状の金属部材が外側キャップの透孔から内側キャップとの間の空隙部に入り込んで両キャップを電気的に接続し、電池を短絡させるようなことはない。

【0079】上記の実施例においては、内側キャップおよび外側キャップに設けたガス抜きのための透孔はそれぞれ4個であるが、透孔の数はその大きさや電池に応じて適宜選択すべきことである。

【0080】また、電池の正極を外側キャップと電気的に接続する構成としたが、電池の正極を内側キャップと接続する構成とすることもできる。

【0081】PTC素子は、1つの部品としてプリント基板と弁体との間に挿入したが、プリント基板上の素子72内に組み入れることもできる。

【0082】また、上記各実施例において示した材料等は一例であり、機能を果たす範囲内で変更して用いることができる。

【0083】さらに、上記の実施例においては、本発明をリチウムイオン二次電池に適用した例を説明したが、本発明はその他の二次電池にも同様に適用できることはいうまでもない。

【0084】

【発明の効果】以上説明したように本発明によれば、単体で過充電、過放電にならないよう制御し、二次電池内のガス圧が異常に高まるような事態を防止するとともに、なおかつ二次電池内のガス圧が異常な高圧となるときには、速やかにガスを放出して電池の破裂を未然に防止することができる二次電池を得ることができる。

【0085】本発明は以上説明したような形態で実施することにより、従来のパック形電池で問題点とされていた以下の課題を解決することができる。

【0086】1) パック形電池が被供給装置に装着できる形状およびデザインの筐体になっているために、被供給装置向けの専用パックとなってしまうこと。

【0087】2) 電池パックが被供給装置に装着できる形状およびデザインの筐体になっているために、充電器もパック形電池に合わせた、または被供給装置の収納部を含めた専用充電器となってしまうこと。

【0088】3) 安全回路や被供給装置に装着するため

の形状およびデザイン、端子構造を設けたパック形電池の体積は、パック形電池内に収納される電池の体積に比べ必ず大きくなること。

【0089】4)一般消費者がリチウムイオン等の二次電池単体入手できないこと。更に、あらかじめリチウムイオン等の二次電池のサイズを規定しておけば、被供給装置個々の形状、デザイン、発売時期、発売量にとらわれることなく、二次電池を潤沢に生産供給することが可能になると共に、一般消費者においても、前述の電池が適用される機器を購入すれば、必要な時に必要な量の二次電池を容易に入手することが可能になるという有利な効果が得られる。

【図面の簡単な説明】

【図1】パック形のリチウムイオン二次電池の模式図

【図2】本発明の実施例1における円筒型リチウムイオン二次電池の封口部の断面図

【図3】(a)同封口部の分解斜視図

(b)同封口部の分解断面図

【図4】本発明の実施例1における安全回路のブロック図

【図5】同安全回路の変形を示すブロック図

【図6】同安全回路の他の変形を示すブロック図

【図7】図4に示す安全回路を組み込んだ実施例2における封口部の断面図

【図8】(a)同封口部の分解斜視図

(b)同封口部の分解断面図

【図9】実施例3における封口部の断面図

【図10】実施例4における封口部の断面図

【図11】(a)パッケージ仕様にした安全回路の正面図

(b)同安全回路の側面図

(c)同安全回路の分解斜視図

【図12】(a)安全回路用マイナス極の正面図

(b)イーイー'線断面図

【図13】(a)二次電池の被制御入出力用プラス極の平面図

(b)ローロー'線断面図

【図14】実施例5における組立封口板を備えたリチウムイオン二次電池の要部の縦断面図

【図15】実施例6における組立封口板の要部の縦断面図

【図16】電池内に組み入れられている安全装置を含む電気回路を示す図

【図17】パック形のリチウムイオン二次電池における従来の安全回路のブロック図

【符号の説明】

17 フィルター

18 サブフィルター

19 インナーガasket

20 弁体

21 PTC素子

22 キャップ

27 安全回路

28 二次電池

32 電流遮断素子

34 サーミスタ

37 安全回路用マイナス極

38 フレキシブル配線板

39, 39a 被制御入出力用プラス極

41, 42, 49 熱硬化型接着剤

60, 80 組立封口板

61, 81 内側キャップ

62, 82 透孔

63, 83 絶縁性皮膜

64, 84 鋳部

65, 85 外側キャップ

66, 86 透孔

67, 87 鋳部

68, 69, 88, 89 接着剤

70 プリント基板

71 透孔

72 素子

73 PTC素子

74 弁体

75 サブフィルター

76 透孔

77 フィルター

78 透孔

79 インナーガasket

90 電池ケース

91 極板群

92 絶縁板

93 正極リード板

94 ガasket

95, 97 空洞部

96, 98 膨出部

100 電池

101 スイッチ

102 電圧検出器

103 電流遮断素子

104 コンデンサ

105 スイッチ

106 温度ヒューズ

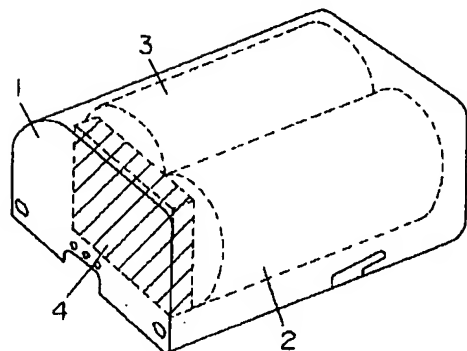
107 サーミスタ

A スリット

B, C, D, E, H, J 透孔

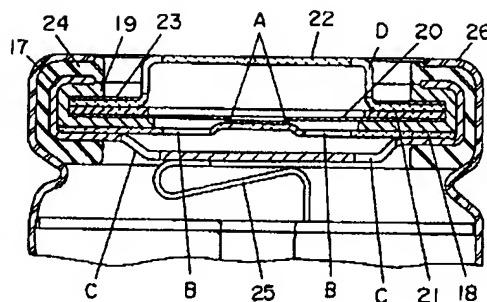
【図1】

- 1...筐体
2,3...リチウムイオン二次電池
4...安全回路

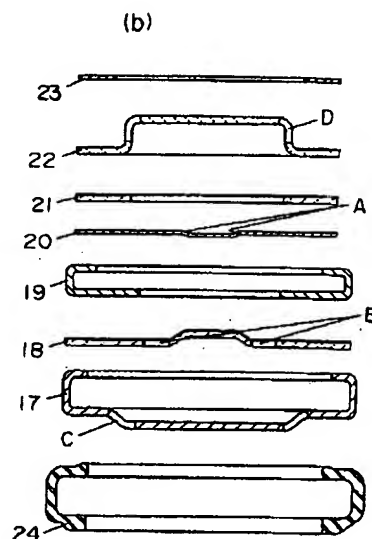
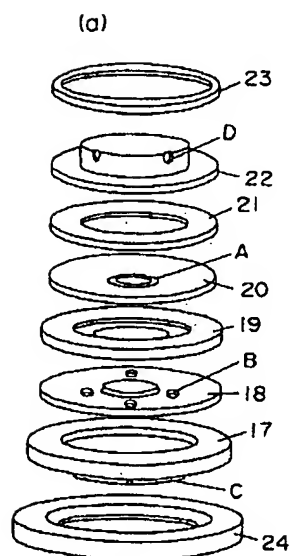


【図2】

- 17...フィルター
18...サブフィルター
19...インナーガスケット
20...弁体
21...PTC素子
22...キャップ
23...封口板リング
24...ガスケット

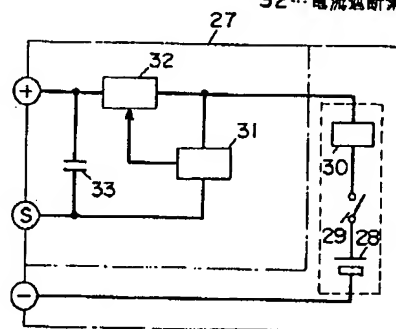


【図3】



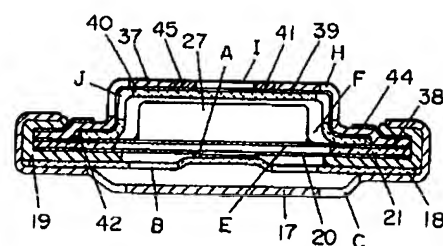
【図4】

- 27...安全回路
28...二次電池
30...PTC素子
32...電流遮断素子

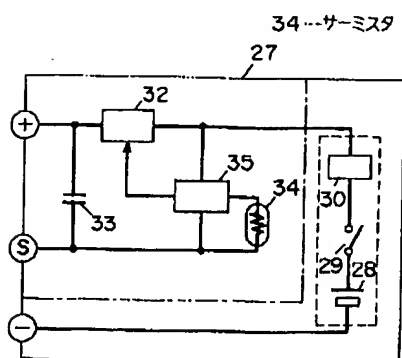


【図7】

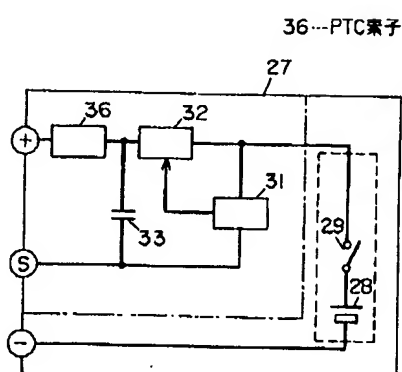
- 37...安全回路用マイナス極
38...フレキシブル配線板
39...二次電池の被制御入出力用プラス極
41, 42...熱硬化型接着剤



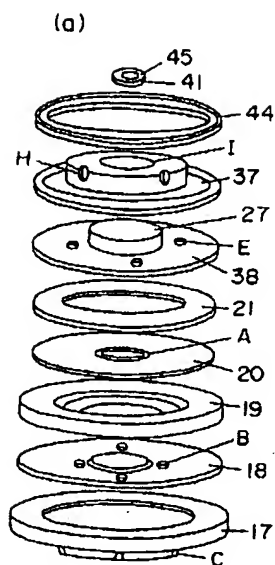
【図5】



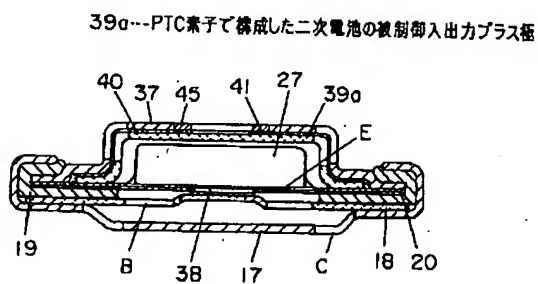
【図6】



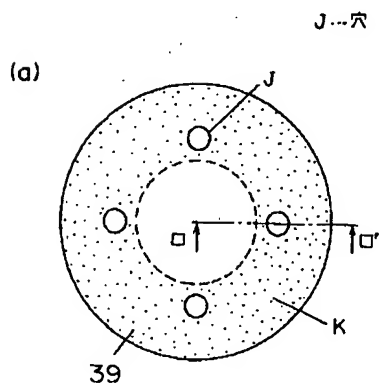
【図8】



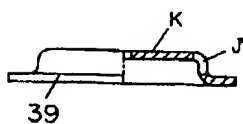
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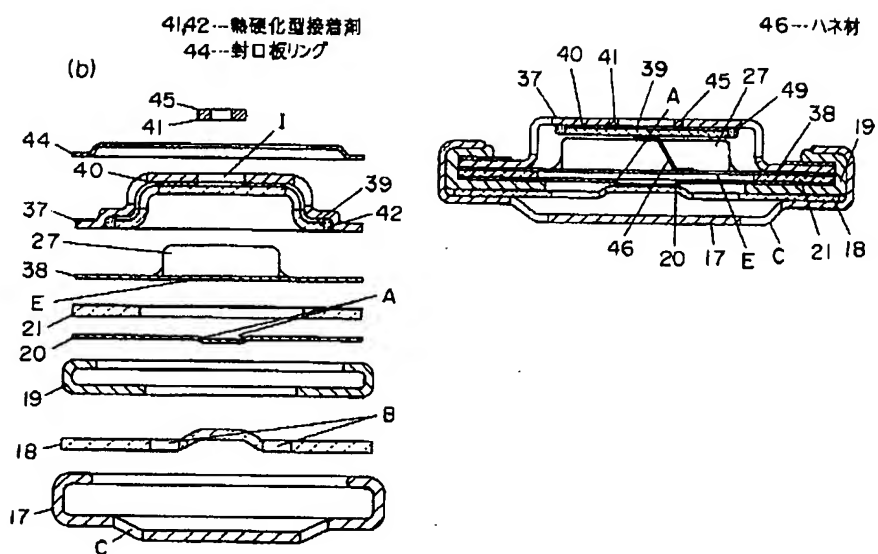
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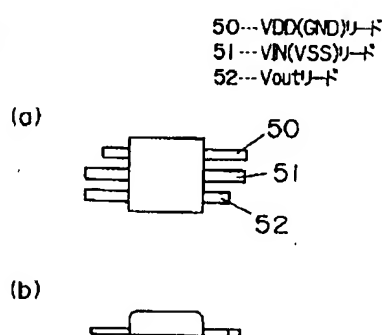
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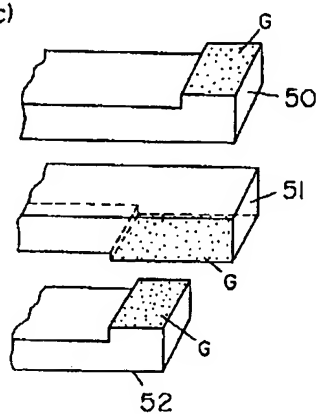
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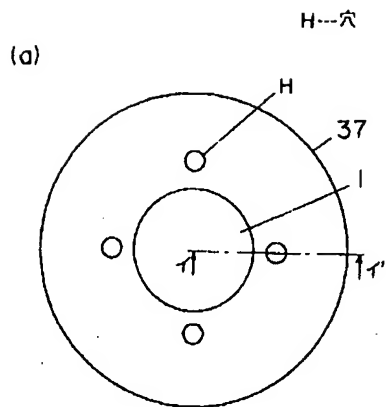
【図11】



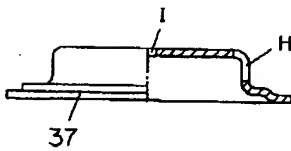
(c)



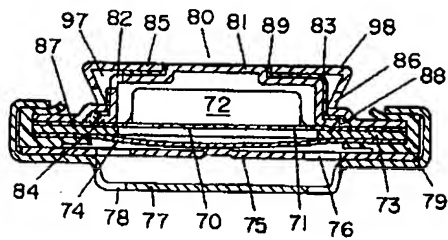
【図12】



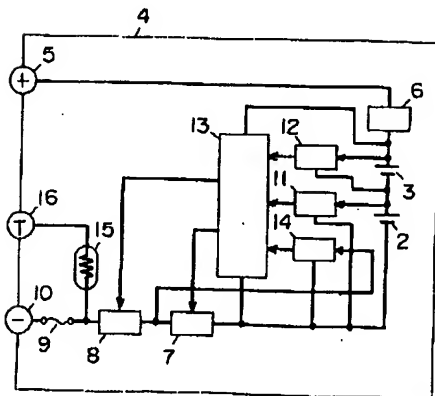
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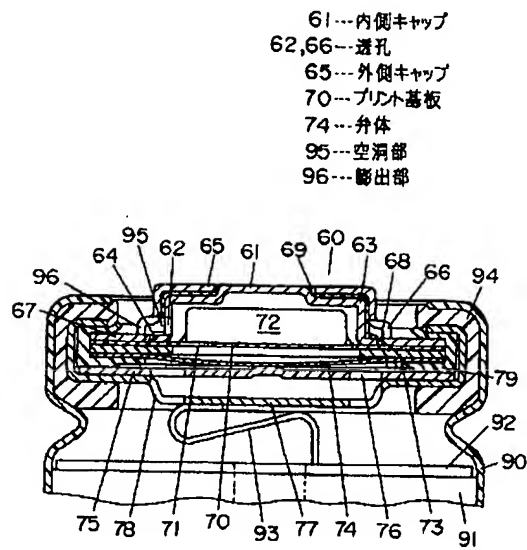
【図15】



【図17】



【図14】



【図16】

